INSTRUCTION MANUAL

PRELIMINARY
INSTRUCTION MANUAL

UNIVERSAL TONE GENERATOR

MODEL TG-1

MANUAL NO. 1-500783-218

SINGER
INSTRUMENTATION

PRELIMINARY
INSTRUCTION MANUAL

UNIVERSAL TONE GENERATOR

MODEL TG-1

MANUAL NO. 1-500783-218

Issued 4-20-72

NOTICE - A patent is pending on the circuits and concepts used in this instrument.

SINGER INSTRUMENTATION
LOS ANGELES OPERATION
3211 South La Cienega Boulevard
Los Angeles, California 90016

WARRANTY

SINGER INSTRUMENTATION, Los Angeles Operation, warrants each new instrument to be free from defects in material and workmanship, effective after delivery to the original purchaser as follows:

TCXO Oscillator	2 years
Sensitive Research* Electrical Indicating Instruments	2 years
Other Electrical and Electronic Measuring Instruments	1 year

Repair or replacement (at our option) without charge (F. O. B. factory) will be effected when our examination satisfactorily indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuses, lamps, thermoelements, and RatioTran potentiometers are excluded from warranty coverage. Warranty returns must first be authorized by the factory.

If the instrument or any portion thereof, has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void.

This warranty is in lieu of all other obligations or liabilities expressed or implied and The Singer Company neither assumes, nor authorizes any person to assume for them, any other liability in connection with sales of instruments manufactured by SINGER INSTRUMENTATION, Los Angeles Operation.

THE SINGER COMPANY, LOS ANGELES OPERATION
3211 South LaCienega Boulevard
Los Angeles, California 90016

REPAIR AND MAINTENANCE

Instruments should be returned only on prior written authorization from the Singer Representative or the factory. Warranty repair will be made upon written request. Please provide the following information in order to expedite our processing of your instrument:

1. Model or Type
2. Serial Number
3. Description of trouble(1)
4. Test instruments used
5. Approximate date instrument was placed in operation
6. Approximate number of hours of use
7. Has maintenance action been previously requested.
8. Other comments

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument to the factory prepaid. If requested, an estimate of charges will be made before work begins.

(1) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

PLACE
STAMP
HERE

THE SINGER COMPANY
ELECTRONIC PRODUCTS DIVISION
GERTSCH OPERATION
3211 S. La Cienega Blvd.
Los Angeles, California 90016

TABLE OF CONTENTS

SECTION	DESCRIPTION	PAGE NO.
I	Introduction	1-1
II	Installation	2-1
III	Operation	3-1
IV	Theory of Operation	4-1
V	Maintenance	5-1
VI	Installation Procedure for Upgrading TG-1	6-1
VII	Parts Lists	7-1

TABLES

TABLE	DESCRIPTION	PAGE NO.
1-1	Tone Formats	1-4
1-2	Specifications	1-6
3-1	Front Panel Operating Controls, Indicators & Connectors, TG-1	3-3
3-2	Rear Panel Controls & Connections	3-8
3-3	Remote Control Connections (J3)	3-24

TABLE OF CONTENTS (contd)

FIGURES

FIGURE	DESCRIPTION	PAGE NO.
1-2	Timing Diagram (f1——→f2 Mode Selected)	1-5
3-1	Front Panel Operating Controls, Indicators & Connectors	3-2
3-2	Rear Panel Operating Controls & Connectors	3-7
3-3	Secode Output Waveform	3-15
3-4a	Set-up for Secode Output	3-15
3-4b	Set-up for IMTS Output	3-15
3-5	IMTS Output Waveform	3-17
3-6	Frequency Programming Input Circuit	3-17
3-7	Cascading Interface Schematic Diagram	3-23
4-1	Frequency Synthesis Block Diagram	4-2
5-1	Correct Triangular Output Waveform	5-11
5-2	Incorrect Output Waveform	5-12
6-1	f3, f4 Thumbwheel Harness Connection Diagram	6-4
6-2	Programming Connector Harness Connection Diagram	6-5

SECTION I

INTRODUCTION

1.1 GENERAL

Universal Tone Generator Model TG-1 is an accessory for use with any signal generator capable of FM or AM modulation. It equips the generator to service tone-selective communications equipment such as paging units and paging receivers with selective tone code circuitry and decoders.

1.2 TONE FORMATS

The TG-1 generates frequencies from 0.1 Hz to 9999.9 Hz in all varieties of tone formats required for tone-selective testing. The various tone formats available are shown in Table 1-1. A typical timing diagram is illustrated in Figure 1-2 showing the tone relationships between two sequential tone bursts. Timing controls are provided for controlling the duration of each tone burst, the pause between bursts and the delay between repeated cycles. All tones in the TG-1 are derived from a crystal oscillator of ± 50 ppm accuracy. Output level can be varied from zero to 3 V peak to peak. Provision is made for individual adjustment of tone levels.

1.3 MODELS AVAILABLE

Six variations of the TG-1 are available:

TG-1A

TG-1B

TG-1C

TG-1AP, TG-1BP, TG-1CP } PROGRAMMABLE

The most complete unit is Model TG-1CP. It has all the functions described in this manual, including remote programming capability. Three frequency synthesizer boards (A1, A2 and A3) are included.

TG-1A

This model is not capable of supplying two or three tones simultaneously. However, it will supply two sequential tone bursts of different frequencies (f1 ⟶ f2). It will also supply a single tone continuously or in single tone bursts. The TG-1A contains only one frequency synthesizer board (A3) and thumbwheels f^3 and f4 are omitted. Integrated circuits AR1 to AR5 are also omitted from assembly A4.

TG-1B

This model will perform all the functions of the TG-1C except three tones simultaneous (f1, f'2, f3).

TG-1C

This is the basic model with all functions except programmability.

TG-1AP

Same as TG-1A with remote programmability.

TG-1BP

Same as TG-1B with remote programmability.

TG-1CP

Same as TG-1C with remote programmability.

1.4 APPLICATIONS

The TG-1 can be used to test a wide variety of tone-selective systems.

EXAMPLES

Private Line** (continuous tone on RF carrier)

Tone Alert (1 tone burst)

Bellboy* (3 tone simultaneous)

Quik-Call** (2⟶2 sequential)

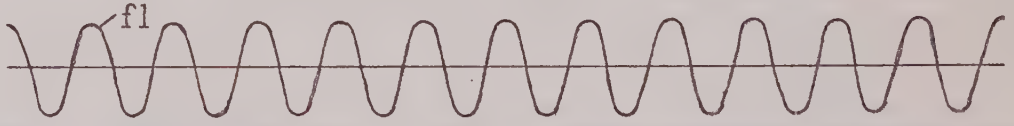
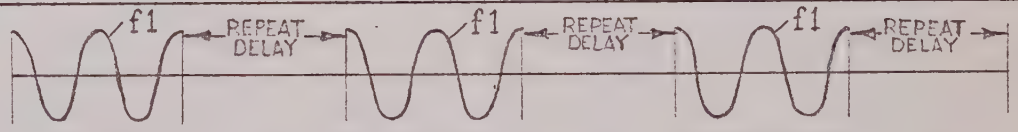
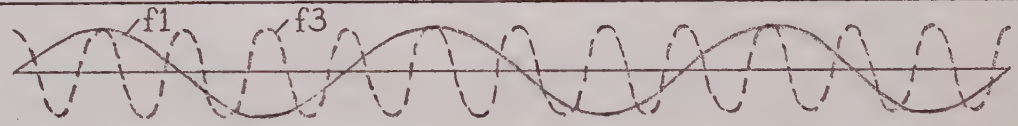
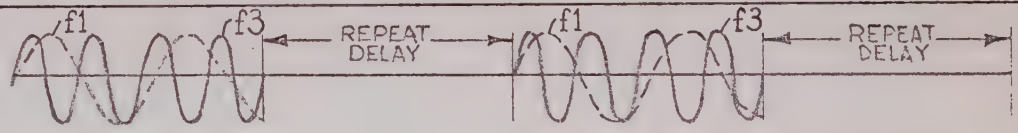
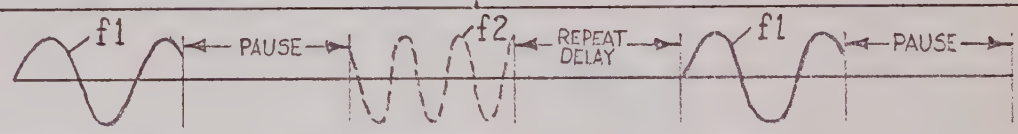
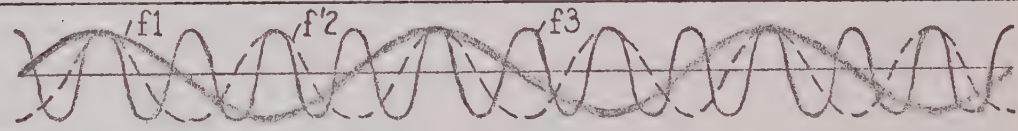
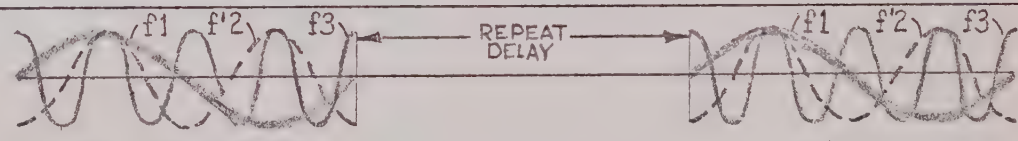
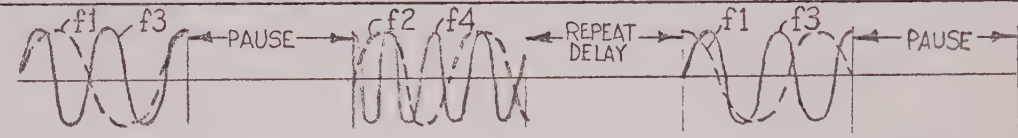
Sel-Call** (2⟶2 sequential)

Secode*** (2805 Hz interrupted)

and others

* Bell System trademark
** Motorola trademark
*** Secode Electronics trademark

TABLE 1-1
TONE FORMATS

MODE SWITCH SELECTED	NO. TONES	TIME FORMAT	PICTORIAL REPRESENTATION
f1	1	continuous	
f1	1	bursts	
f1, f3	2	cont/simultaneous	
f1, f3	2	bursts/simultaneous	
f1 ⟶ f2	2	sequential bursts	
f1, f'2, f3	3	continuous/simult.	
f1, f'2, f3	3	bursts/simultaneous	
[f1 ⟶ f2] [f3 ⟶ f4]	4	sequential bursts	

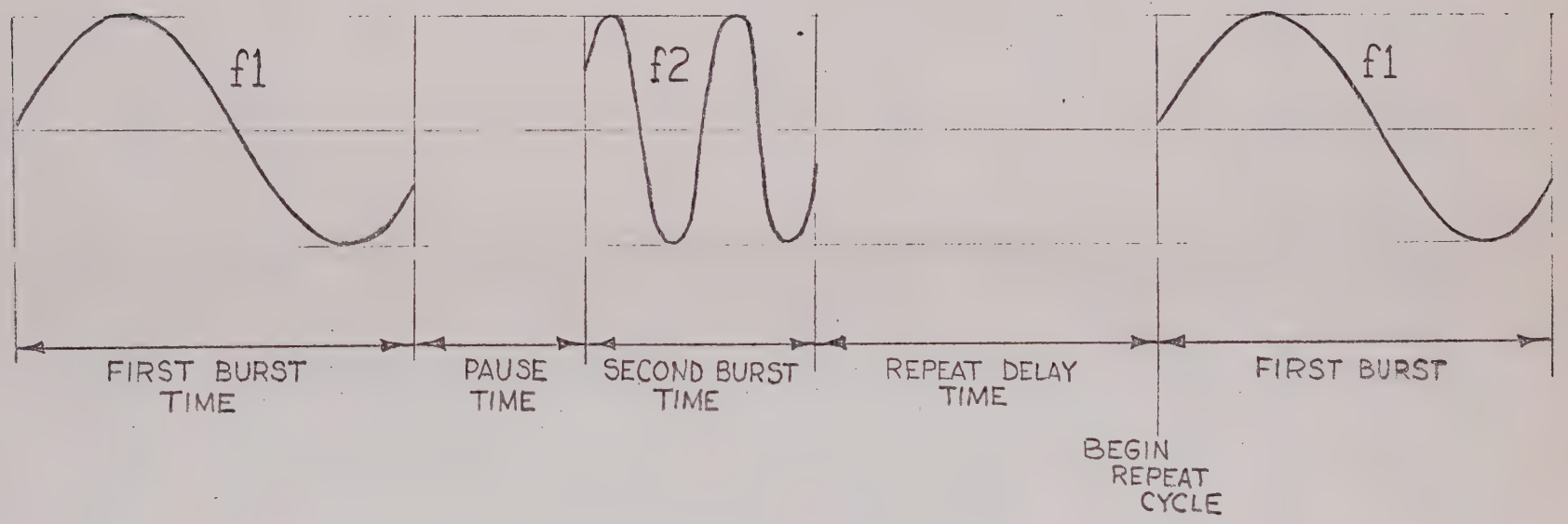


Fig 1-2 Timing Diagram
(f1⟶f2 Mode Selected)

TABLE 1-2

SPECIFICATIONS

1.	Frequency range:	0.1Hz to 9999.9Hz (Low frequency 3 dB point less than 20Hz with 600 ohm load)
2.	Accuracy:	±50 ppm, crystal controlled
3.	Resolution:	0.1Hz
4.	Output:	Sinusoidal; impedance: 600 ohms nominal. Output amplitude for single frequency variable from 0 to 3V p-p ±10% continuous (no-load). Distortion 5% max. Typically 2.5% at 25°C.
5.	Modes available:	One-tone continuous (1) One-tone burst (1) Two-tone continuous (2) (TG-1B, TG-1C) Two-tone burst sequential (1→1) Four-tone simultaneous burst sequential (2→2) (TG-1B, TG-1C) Three-tone simultaneous (3) (TG-1C)
6.	4 sets of frequencies may be "dialed in"	
7.	Timing ranges:	
	FIRST BURST:	Continuous, 0.1 to 1 sec., 1 to 10 sec.
	PAUSE:	ZERO, 0.1 to 1 sec., 1 to 10 sec.
	SECOND BURST:	0.1 to 1 sec., 1 to 10 sec.
	REPEAT DELAY:	ZERO, 0.5 to 5 sec., 5 to 50 sec.

8.	Power requirements:	115/230 VAC, 50 to 400Hz 12-16 VDC, 3A (max)
9.	Temperature:	-5°C to +50°C
10.	Size:	10" W x 7" H x 12" D (approx)
11.	Weight:	12 pounds (approx)
12.	Fuses:	AC and DC
13.	Front panel controls:	Four 5-digit frequency controls
		Mode switch (5 position standard)
		Timing controls (four total)
		Start sequence control
		Output controls single/repeat and level
		Output connector BNC
14.	Rear panel:	External telephone dial input connector(s)
		Remote programming connector
		Individual tone level controls
		AC/DC switch
		115/230 VAC switch
		12 VDC connector
		Fuses
15.	Options:	Remote frequency programming, BCD (8, 4, 2, 1)

SECTION II

INSTALLATION

2.0 GENERAL

2.1 Check the instrument mechanically for signs of damage, loss of hardware such as knobs, etc.

2.2 Check the instrument electrically by performing the performance check procedure presented in Section V.

2.3 To prepare for use, simply plug-in to an AC source and turn on power switch. For DC source use J4 connector on the rear panel.

SECTION III

OPERATION

3.1 INTRODUCTION

Operation of the Universal Tone Generator, Model TG-1 is extremely simple. It can be operated entirely from the front panel controls and requires no calibration before use.

The instrument has numerous operating modes which equip it to be used for testing most proprietary tone-selective systems such as: Bellboy (Bell System trademark), Quik-Call/Sel-Call/Private Line (Motorola trademarks), Secode (Secode Electronics trademark), Tone Alert, etc.

Front and rear panel operating controls, indicators and connectors are described fully in Tables 3-1 and 3-2.

3.2 MODES OF OPERATION

There are three basic modes of operation: continuous, single burst and sequential bursts. Each of these modes may include more than one tone. The complete matrix of modes is shown in Table 1-1.

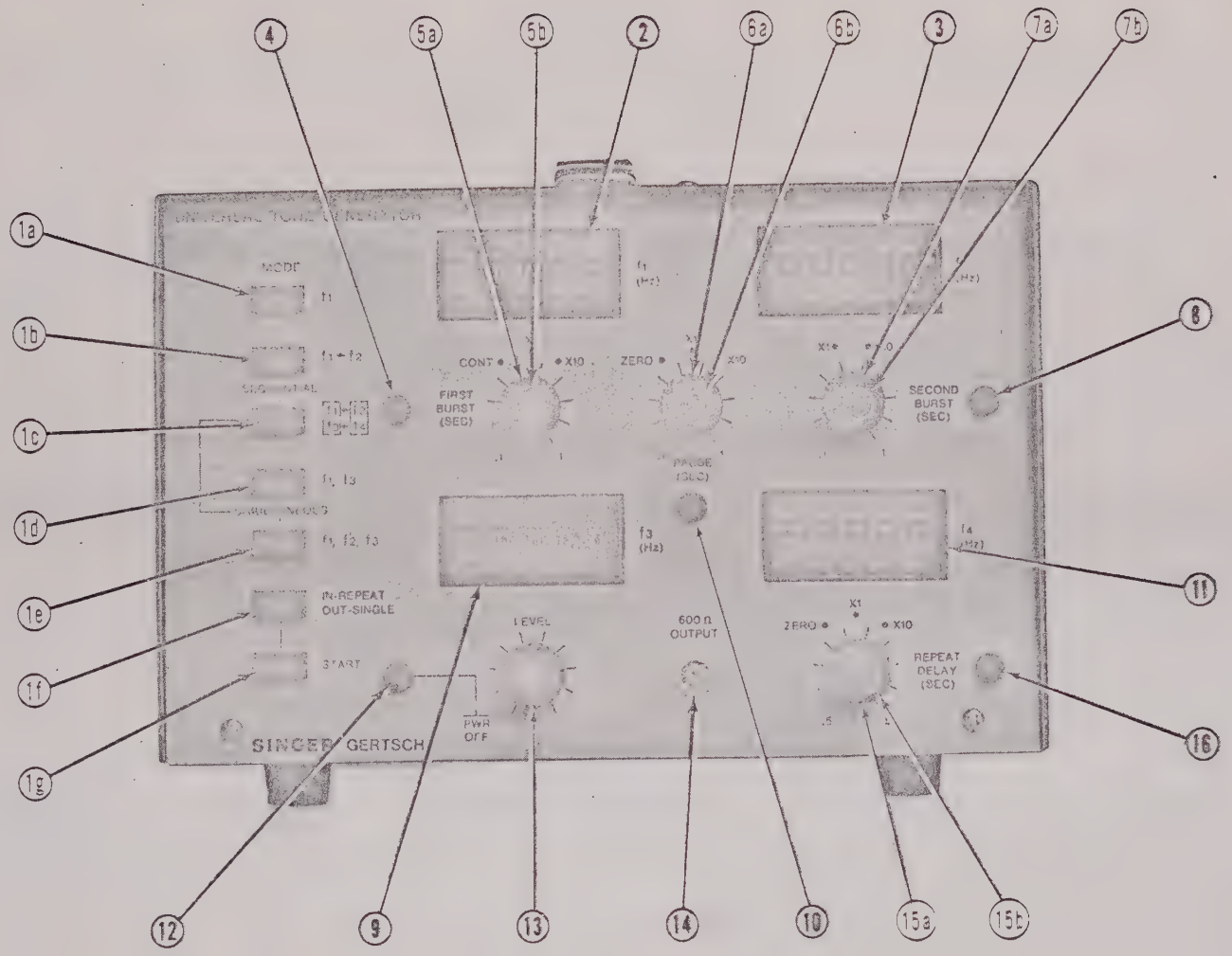


Fig 3-1 Front Panel Operating Controls, Indicators and Connectors

TABLE 3-1

FRONT PANEL OPERATING CONTROLS, INDICATORS AND CONNECTORS, TG-1
(KEYED TO FIGURE 3-1)

ITEM	NOMENCLATURE	TYPE	FUNCTION
1	MODE		
1a	f1	Switch pushbutton	Only f1 appears at the output when this mode is selected. Duration is controlled by FIRST BURST control (Item 5).
1b	f1 → f2 (SEQUENTIAL)	Switch pushbutton	In this mode, f1 appears at the output for a duration controlled by FIRST BURST control (Item 5) followed by a pause controlled in duration by PAUSE control (Item 6) followed in turn by f2 controlled in duration by SECOND BURST control (Item 7). NOTE: if FIRST BURST control is at CONTinuous, f1 will appear continuously.
1c	[f1 → f2] [f3 → f4] (SEQUENTIAL)	Switch pushbutton	In this mode, f1 and f3 appear at output simultaneously both for the same burst duration controlled by FIRST BURST control. They are followed by a pause followed by f2 and f4 simultaneously for a duration controlled by SECOND BURST control.
1d	f1, f3 (SIMULTANEOUS)	Switch pushbutton	In this mode, f1 and f3 appear at output simultaneously. Duration is controlled by FIRST BURST control.

TABLE 3-1

FRONT PANEL OPERATING CONTROLS, INDICATORS AND CONNECTORS, TG-1
(KEYED TO FIGURE 3-1)

ITEM	NOMENCLATURE	TYPE	FUNCTION
1e	f1, f'2, f3 (SIMULTANEOUS)	Switch pushbutton	In this mode f1, f'2 and f3 appear at output simultaneously. Duration is controlled by FIRST BURST control.
1f	IN-REPEAT OUT-SINGLE	Switch pushbutton	At IN position, the selected tone mode will repeat continuously with a repeat delay controlled by REPEAT DELAY (Item 15). At OUT position, the tone mode selected will not repeat. To obtain another tone cycle, the START switch (Item 1g) must be pressed.
1g	START	Switch pushbutton	This switch initiates the tone cycling operation of the instrument in both SINGLE and REPEAT modes.
2	f1 (Hz)	Switch thumbwheel	Selects frequency f1 from 0.1Hz to 9999.9Hz.
3	f2 (Hz)	Switch thumbwheel	Selects frequency f2.
4		Indicator Light	Indicates when f1 appears at output, for duration of burst.

TABLE 3-1

FRONT PANEL OPERATING CONTROLS, INDICATORS AND CONNECTORS, TG-1
(KEYED TO FIGURE 3-1)

ITEM	NOMENCLATURE	TYPE	FUNCTION
5	FIRST BURST (SEC)	a. Switch, 3 position	In CONT position, first burst is continuous. In X1 position, calibration is in seconds as marked. In X10 position, scale markings multiplied by 10.
		b. Potentiometer	Controls tone burst duration from 0.1 to 1 sec or from 1 to 10 secs.
6	PAUSE (SEC)	a. Switch, 3 position	In ZERO position, pause is zero. In X1 position, calibration is in seconds. In X10 position, calibration is multiplied by 10.
		b. Potentiometer	Controls pause from 0.1 to 1 sec or from 1 to 10 secs.
7	SECOND BURST (SEC)	a. Switch, 2 position	In X1 position, calibration is in seconds as marked. In X10 position, scale markings multiplied by 10.
		b. Potentiometer	Controls tone burst duration from 0.1 sec to 1 sec or from 1 sec to 10 secs.

TABLE 3-1

FRONT PANEL OPERATING CONTROLS, INDICATORS AND CONNECTORS, TG-1
(KEYED TO FIGURE 3-1)

ITEM	NOMENCLATURE	TYPE	FUNCTION
8		Indicator Light	Indicates when f2 appears at output, for duration of burst.
9	f3 (Hz)	Switch thumbwheel	Selects frequency f3.
10		Indicator Light	Indicates pause duration between sequential bursts.
11	f4 (Hz)	Switch thumbwheel	Selects frequency f4.
12	PWR OFF	Indicator Light	Indicates power "ON" condition.
13	LEVEL	Potentiometer	Controls output level.
14	600 OHM OUTPUT	Connector	Output connector.
15	REPEAT DELAY (SEC)	a. Switch, 3 position	In ZERO position, delay is zero. In X1 position, delay is 0.5 to 5 secs. In X10 position, delay is 5 to 50 secs.
		b. Potentiometer	Controls repeat delay duration from 0.5 to 5 sec or from 5 to 50 secs.
16		Indicator light	Indicates repeat delay duration.

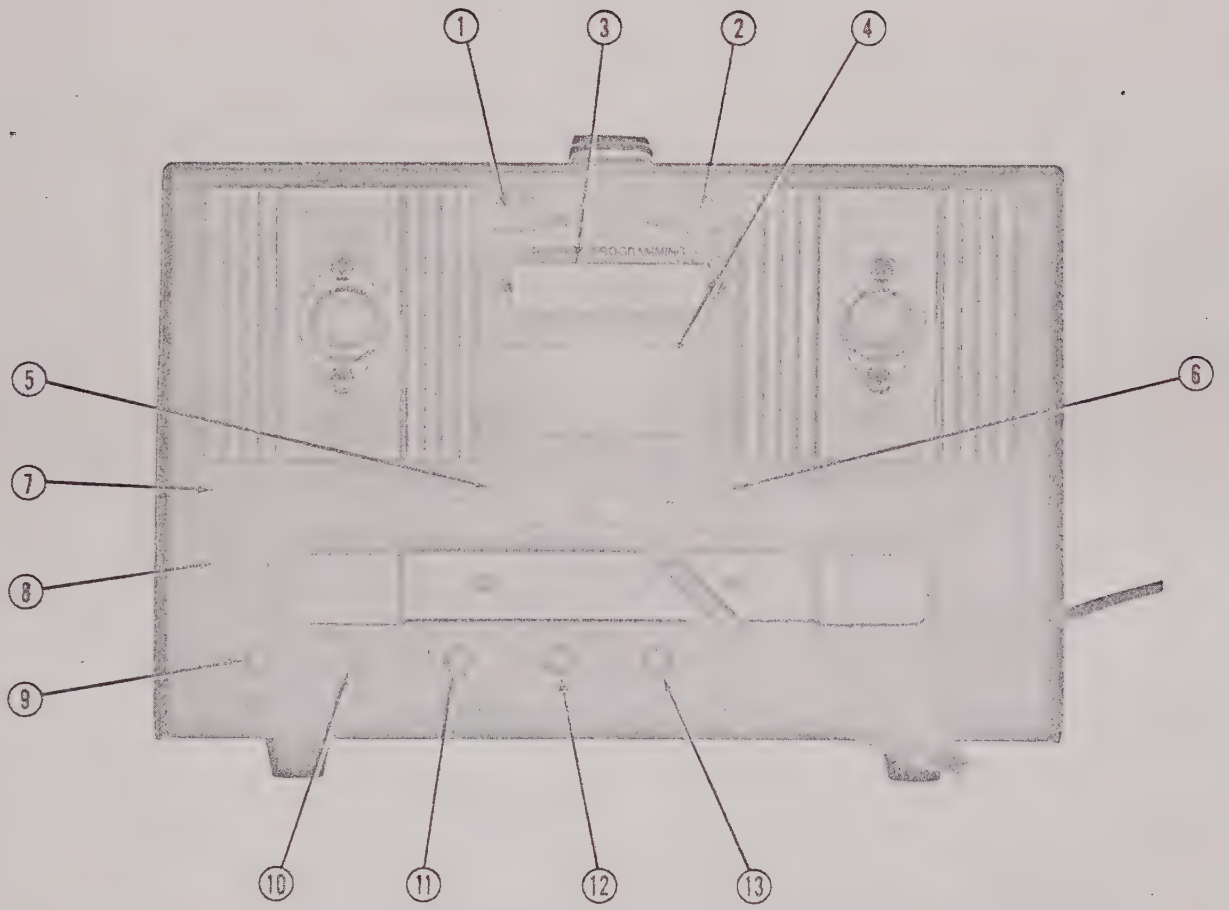


Fig 3-2 Rear Panel Operating Controls and Connectors

TABLE 3-2

REAR PANEL CONTROLS AND CONNECTIONS
(KEYED TO FIGURE 3-2)

ITEM	NOMENCLATURE	TYPE	FUNCTION	
1	AC-DC	Switch	Selects AC or DC operation	
2	115/230V	Switch	Selects 115V or 230V operation	
3	REMOTE PROGRAMMING	Connector	Accepts inputs for remote programming	
4	12V DC	Connector	12V dc input connector	
5	F1	Fuse 3/4A slo-blo	Protects AC input circuit	
6	F2	Fuse 3A slo-blo	Protects DC input circuit	
7	J1	Connector	Remote telephone dial input	for Secode and IMTS output
8	J2	Connector	Remote telephone dial input	
9	f3	Potentiometer	Adjusts output level of f3	
10	f4	Potentiometer	Adjusts output level of f4	
11	f'2	Potentiometer	Adjusts output level of f'2	
12	f1	Potentiometer	Adjusts output level of f1	
13	f2	Potentiometer	Adjusts output level of f2	

3.3 TURN ON TRANSIENTS

The TG-1 may emit an undesired signal for one cycle period when power is first applied. The existence of an undesired output is indicated when more than one of the four indicator lights are lit simultaneously. This condition will last only for the total time settings of the four time controls and will clear automatically. To prevent this spurious first cycle from reaching the external test circuitry, maintain the LEVEL control at maximum CCW position (at which the output level is zero) until all lights are out (except the power light). Since the spurious condition will last for the total time set on the four time controls, the time needed to eliminate the spurious condition can be shortened to 0.2 seconds by setting all four time controls to minimum.

3.4 OPERATING PROCEDURES

3.4.1 Continuous - Single Tone

a. Set controls as follows:

Power (Level Control)	On/Max CCW
MODE f1	IN
f1 (thumbwheel)	Desired frequency
FIRST BURST	CONT.

b. Connect OUTPUT connector to external test circuit.

c. When all indicator lights are out (refer to para 3-3), adjust LEVEL control for desired output. Maximum CW position is approximately 0.5VRMS with a 600 ohm load.

3.4.2 Continuous Two-Tone Simultaneous

Repeat para. 3.4.1 except set MODE switch f1, f3 to IN position.

3.4.3 Continuous Three-Tone Simultaneous

Repeat para. 3.4.1 except set MODE switch f1, f'2, f3 to IN position.

3.4.4 Single Burst - Single Tone

a. Set controls:

Power/Level Control	On/Max CCW
MODE f1	IN
f1 (thumbwheel)	Desired frequency
FIRST BURST	Desired duration

b. Connect OUTPUT connector to external test circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch. Note, all indicator lights must be out before starting.

3.4.5 Single Burst - Two Tone Simultaneous

a. Set controls:

Power/Level control	ON/Max CCW
MODE f1, f3	IN
f1 (thumbwheel)	Desired frequency
f3 (thumbwheel)	Desired frequency
FIRST BURST	Desired duration

b. Connect OUTPUT connector to external circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

3.4.6 Single Burst - Three-Tone Simultaneous

a. Set controls:

Power/Level Control	On/Max CCW
MODE f1, f'2, f3	IN
f1 (thumbwheel)	Desired frequency
f2 (thumbwheel)	Desired frequency
f3 (thumbwheel)	Desired frequency
FIRST BURST	Desired duration

b. Connect OUTPUT connector to external test circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

3.4.7 Sequential Bursts, f1——→f2

a. Set controls:

Power/Level control	On/Max CCW
MODE f1——→f2	IN
f1 (thumbwheel)	Desired frequency
f2 (thumbwheel)	Desired frequency
FIRST BURST	Desired duration

PUASE	Desired duration
SECOND BURST	Desired duration

b. Connect OUTPUT connector to external test circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output.

d. If automatic recycling of the tone bursts is required, set IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

3.4.8 Sequential Bursts [f1, f3] ⟶ [f2, f4]

a. Set controls:

Power/Level control	On/Max CCW
MODE [f1, f3] ⟶ [f2, f4]	IN
f1 (thumbwheel)	Desired frequency
f2 (thumbwheel)	Desired frequency
f3 (thumbwheel)	Desired frequency
f4 (thumbwheel)	Desired frequency
FIRST BURST	Desired duration
PAUSE	Desired duration
SECOND BURST	Desired duration

b. Connect OUTPUT connector to external test circuit.

c. When all indicator lights are out, adjust LEVEL control for desired output.

d. If automatic recycling of the tone burst is required, set REPEAT DELAY to desired delay and push IN-REPEAT/OUT-SINGLE switch to IN position.

e. Push START switch.

3.5 DIAL TONE PULSE TESTING

The TG-1 supplies a Secode tone output waveform when an external telephone dial is connected to the rear panel connectors J1 and J2. The output waveform is shown in figure 3-3.

The set-up procedure is as follows:

a. Set controls:

Power/Level Control	On/Max CCW
MODE f1	IN
f2 (thumbwheel)	Desired frequency

b. Connect OUTPUT connector to external test circuit.

c. Connect telephone dial to J1 and J2 input connectors on rear panel as shown in figure 3-4a.

d. When all indicator lights are out, adjust LEVEL control for desired output.

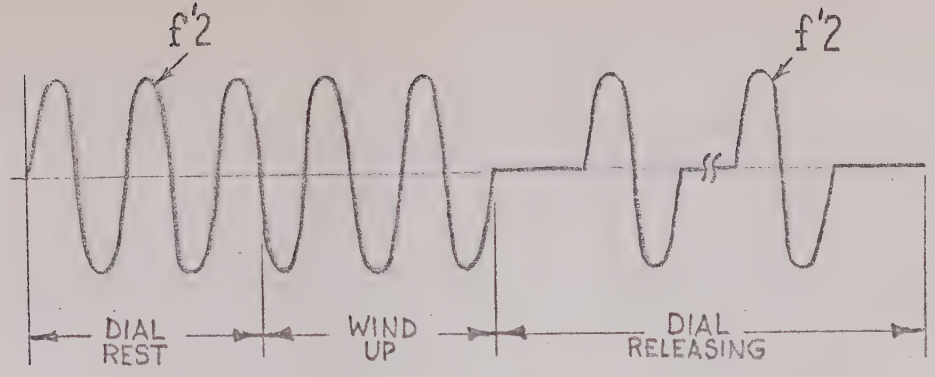


Fig 3-3 Secode Output Waveform

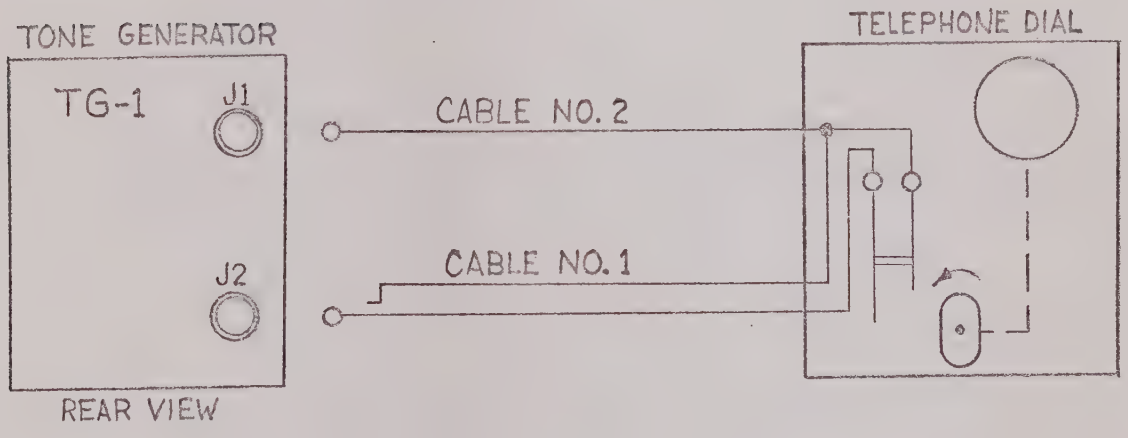


Fig 3-4a Set-up for Secode Output

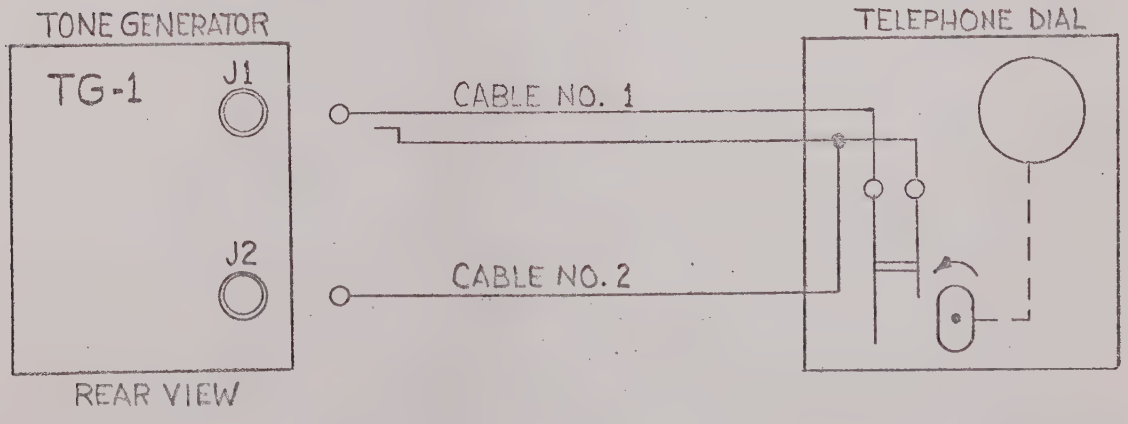


Fig 3-4b Set-up for IMTS Output

3.6 IMTS TESTING

Models TG-1C and TG-1CP can supply an IMTS output waveform when an external telephone dial is connected to rear panel connectors J1 and J2 as shown in figure 3-4b. The output waveform is shown in figure 3-5.

The set-up procedure is as follows:

a. Set controls:

Power/Level Control	On/Max CCW
MODE f1	IN
FIRST BURST	CONT
f1 (thumbwheel)	Desired frequency
f2 (thumbwheel)	Desired frequency

b. Connect OUTPUT connector to external test circuit.

c. Connect telephone dial to J1 and J2 connectors on rear panel as shown in figure 3-4b.

d. When all indicator lights are out, adjust LEVEL control for desired output.

3.7 INDEPENDENT TONE LEVEL ADJUSTMENTS

The TG-1 has capability for independent adjustment of all four tone output levels by means of potentiometers on the rear panel. The instrument is supplied with all tones at equal level (1.1 vrms) and with all adjustment potentiometers at maximum gain. However, the gain of each tone circuit may

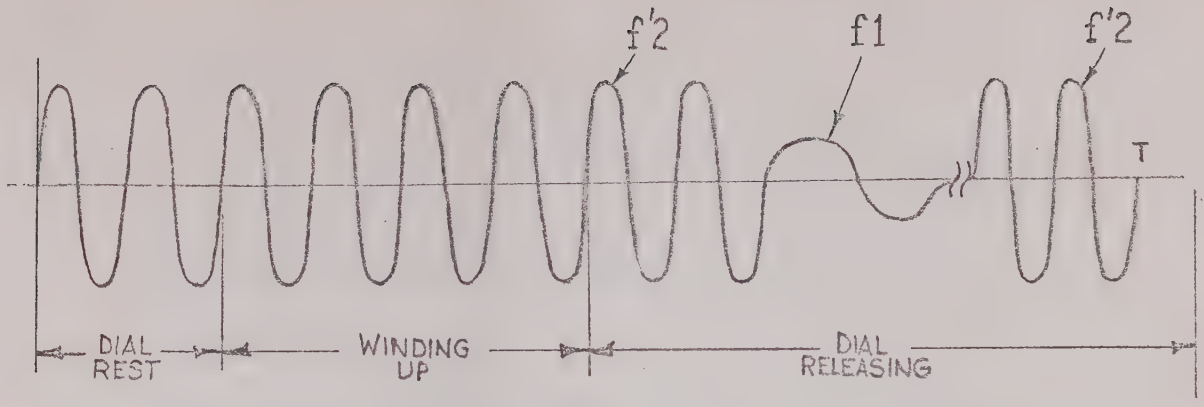


Fig 3-5 IMTS Output Waveform

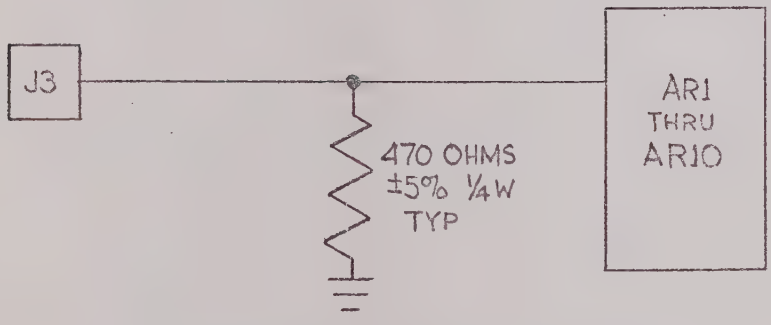


Fig 3-6 Frequency Programming
Input Circuit

be altered independently for specific applications. The output levels of all four tones are also controlled simultaneously by the front panel LEVEL control. See Specifications Table 1-2 for electrical output specifications.

Note that there are two potentiometers on the rear panel for adjusting f2, one labelled f2, and the other labelled f'2. The f'2 pot is used to set the level of f2 when the f1, f'2, f3 simultaneous mode is selected.

3.7.1 Preliminary Procedure

a. Connect oscilloscope to OUTPUT connector.

b. Set front panel LEVEL control to max CW and maintain it in this position while making the independent tone level adjustments below.

3.7.2 Frequency f1 Level Adjustment

a. Set controls:

MODE f1	IN
FIRST BURST	CONT.
f1 (thumbwheel)	Desired frequency

b. Obtain display of frequency f1 on oscilloscope.

c. Adjust potentiometer f1 on rear panel until desired level is obtained.

3.7.3 Frequency f2 Level Adjustment

a. Set controls:

MODE f1 ⟶ f2	IN
FIRST BURST switch	X1
FIRST BURST potentiometer	Max CCW
PAUSE	ZERO
REPEAT DELAY	ZERO
f1 (thumbwheel)	0000.0 Hz
f2 (thumbwheel)	Desired frequency
f3 (thumbwheel)	0000.0 Hz
f4 (thumbwheel)	0000.0 Hz
SECOND BURST switch	X10
SECOND BURST potentiometer	Max CW
REPEAT/SINGLE	IN

b. Push START switch.

c. Obtain display of frequency f2 on oscilloscope.

d. Adjust potentiometer f2 on rear panel until desired level is obtained.

3.7.4 Frequency f3 Level Adjustment

a. Set controls:

MODE f1, f3	IN
FIRST BURST	CONT
f1 (thumbwheel)	0000.0 Hz
f2 (thumbwheel)	0000.0 Hz
f3 (thumbwheel)	Desired frequency
f4 (thumbwheel)	0000.0 Hz

b. Obtain display of frequency f3 on oscilloscope.

c. Adjust potentiometer f3 on rear panel until desired level is obtained.

3.7.5 Frequency f4 Level Adjustment

a. Set controls:

MODE [f1/f3] ⟶ [f2/f4]	IN
FIRST BURST switch	X1
FIRST BURST potentiometer	Max CCW
PAUSE	ZERO
REPEAT DELAY	ZERO
SECOND BURST switch	X10
SECOND BURST potentiometer	Max CW
f1 (thumbwheel)	0000.0 Hz
f2 (thumbwheel)	0000.0 Hz
f3 (thumbwheel)	0000.0 Hz

f4 (thumbwheel)	Desired frequency
REPEAT/SINGLE	IN

b. Push START switch.

c. Obtain display of frequency f4 on oscilloscope.

d. Adjust potentiometer f4 on rear panel until desired level is obtained.

3.7.6 Frequency f'2 Level Adjustment

a. Set controls:

MODE f1, f'2, f3	IN
FIRST BURST	CONT
f1 (thumbwheel)	0000.0 Hz
f2 (thumbwheel)	Desired frequency
f3 (thumbwheel)	0000.0 Hz
f4 (thumbwheel)	0000.0 Hz

b. Obtain display of frequency f2 (same as f'2) on oscilloscope.

c. Adjust potentiometer f'2 on rear panel until desired level is obtained.

3.8 REMOTE CONTROL

Models TG-1AP, TG-1BP, and TG-1CP can be programmed with BCD input for frequency selection, and start and stop can be performed remotely via rear panel connector J3. See Table 3-3 for remote control connector pin functions. Note that all thumbwheels must be at 0000.0 Hz for remote frequency control.

3.9 CASCADING

Two TG-1's can be connected in cascade to perform 4 sequential bursts, as shown in Figure 3-7. Only programmable units can be cascaded.

3.9.1 Single Cycle

To generate one sequential cycle of four (4) bursts perform the following:

a. Set toggle switch S1 to SINGLE (open) position.

b. Set switch (SW9) REPEAT/SINGLE to the single mode (out) position on both TG-1's.

c. Select desired mode and timing on both TG-1's.

d. Connect output as shown in Figure 3-7.

f. Press the pushbutton switch (SW10) START on the TG-1 #1 only. (see para. 3.3).

3.9.2 Repeat Cycle

To obtain cycling operation perform the following:

a. Set switch (SW9) REPEAT/SINGLE to the single mode (out) position on both TG-1's.

b. Select desired mode and timing on both TG-1's.

c. Set toggle switch S1 to SINGLE (open) position.

d. Turn on power on both units (see para. 3.3).

e. Set toggle switch S1 to REPEAT (closed) position.

f. If TG-1 (#1) failed to start press pushbutton switch (SW10) START on TG-1 #1 only.

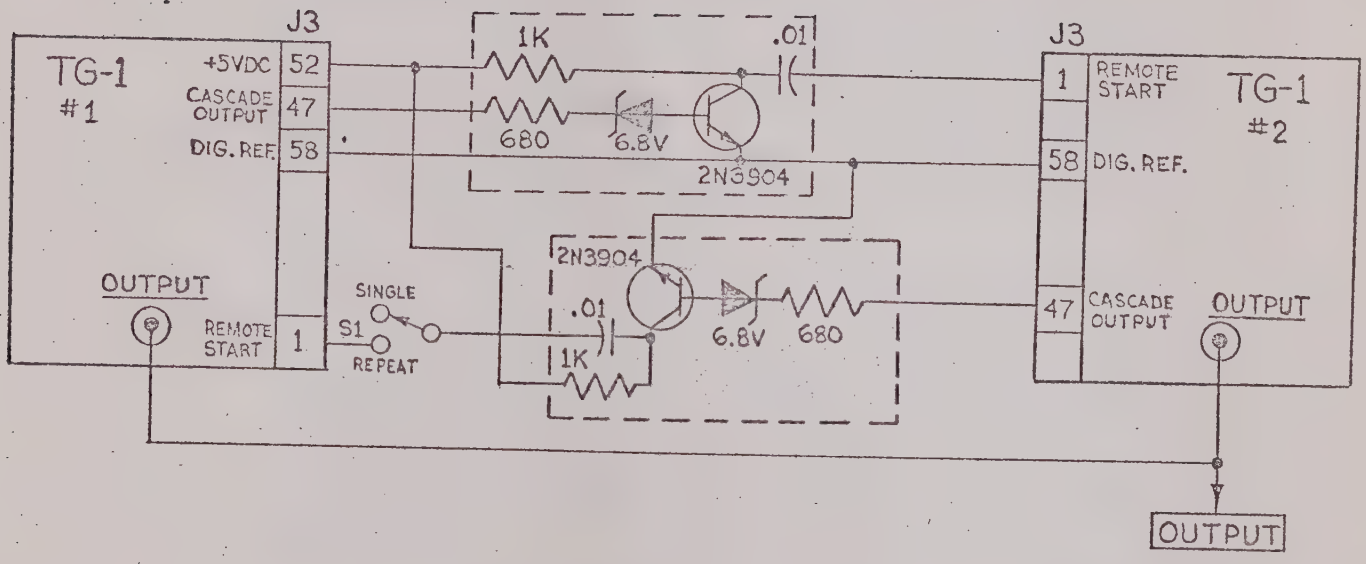


Fig 3-7 Cascading Interface Schematic Diagram

TABLE 3-3

REMOTE CONTROL CONNECTIONS (J3)

A. Digital Common: Pins 58 and 59

B. Remote Start: Pin 1

Starts repeat cycling function. Compatible with T^2L logic.

Logic "1" = 4 ± 1 VDC

Logic "0" = $0^{-0}_{+.5}$ VDC

C. Remote Stop: Pin 44

Stops repeat cycling function. Compatible with T^2L logic.

Logic "1" = $0^{-0}_{+.5}$ VDC

Logic "0" = 4 ± 1 VDC

D. Remote Frequency Programming:

Note: All thumbwheels must be at zero.

Interface is not compatible with T^2L logic. Each input has a pull down resistor as shown in figure 3-6.

Input high:

$I_{IH} \sim 10$ mA

$V_{IH} = +5 \pm 1.$ VDC

Input low: Open or connected to digital common.

E. Output power Available:

+12 VDC Pin 50

+ 5 VDC Pin 52

F. Cascade Output: Pin 47

G. Spare Pins: 41, 45, 46, 48, 49, 51, 53, 54, 55, 56, 57

TABLE 3-3 (contd)

Frequency f1

PIN	BCD (BINARY)	
79	1	10^{+4} (MSD)
80	2	
81	4	
82	8	
83	1	10^{+3}
84	2	
85	4	
86	8	
87	1	10^{+2}
88	2	
60	4	
61	8	
62	1	10^{+1}
63	2	
64	4	
65	8	
66	1	10^{-1} (LSD)
67	2	
68	4	
40	8	

TABLE 3-3 (contd)

Frequency f2

PIN	BCD (BINARY)	
42	1	
43	2	10^{+4} (MSD)
21	4	
22	8	
23	1	
24	2	10^{+3}
25	4	
26	8	
27	1	
28	2	10^{+2}
29	4	
2	8	
3	1	
4	2	10^{+1}
5	4	
6	8	
7	1	
8	2	10^{-1} (LSD)
9	4	
10	8	

TABLE 3-3 (contd)

Frequency f3

PIN	BCD (BINARY)	
39	1	10^{+4} (MSD)
38	2	
37	4	
36	8	
35	1	10^{+3}
34	2	
33	4	
32	8	
31	1	10^{+2}
30	2	
20	4	
19	8	
18	1	10^{+1}
17	2	
16	4	
15	8	
14	1	10^{-1} (LSD)
13	2	
12	4	
11	8	

TABLE 3-3 (contd)

Frequency f4

PIN	BCD (BINARY)	
98	1	10^{+4} (MSD)
97	2	
96	4	
95	8	
94	1	10^{+3}
93	2	
92	4	
91	8	
90	1	10^{+2}
89	2	
78	4	
77	8	
76	1	10^{+1}
75	2	
74	4	
73	8	
72	1	10^{-1} (LSD)
71	2	
70	4	
69	8	

SECTION IV

THEORY OF OPERATION

4.0 GENERAL

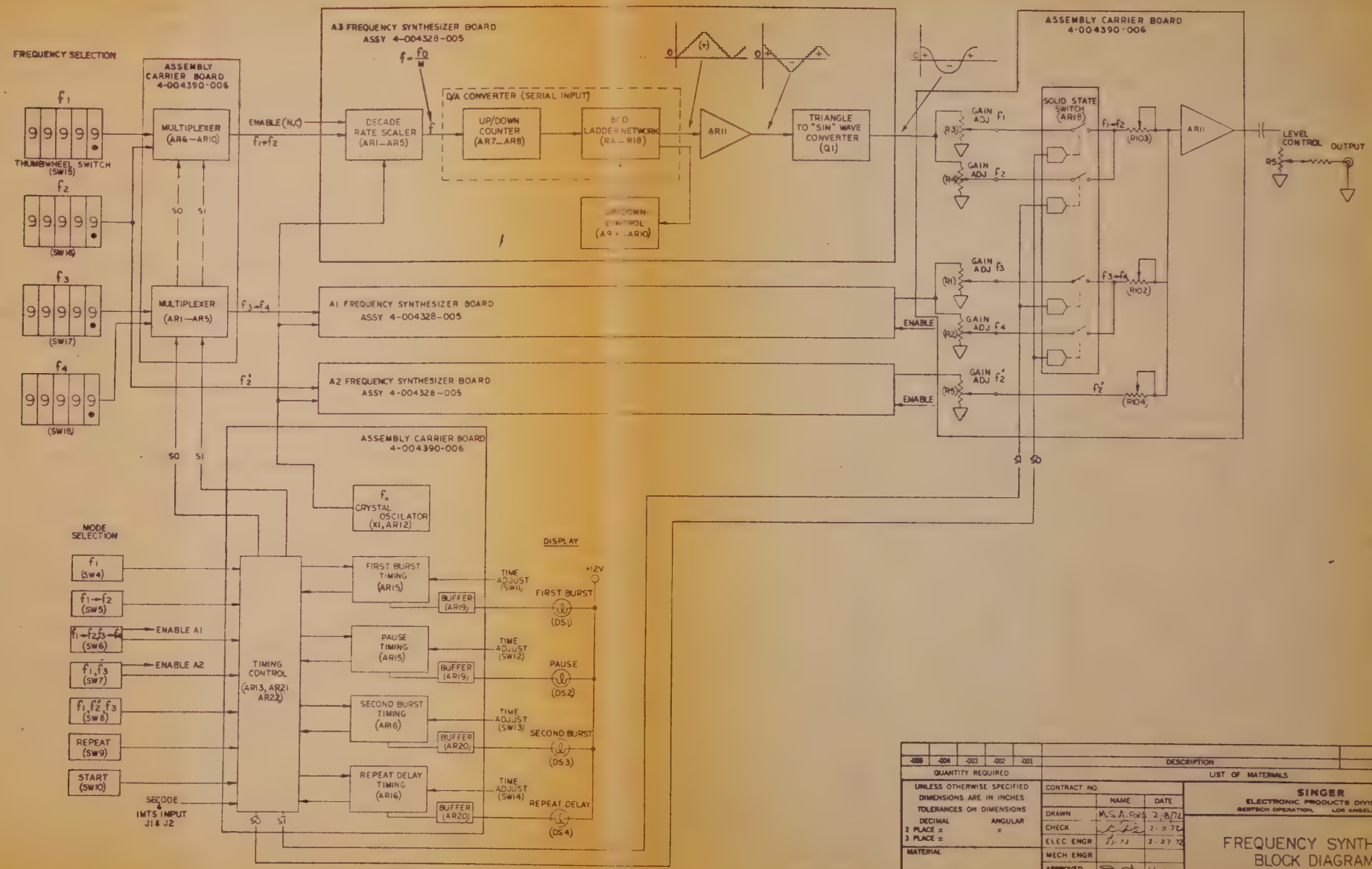
The circuitry of the Tone Generator Model TG-1 falls into two major categories: (1) frequency synthesis circuits and (2) the control logic circuits. The theory of operation for these two groups of circuits provides a comprehensive understanding of the instrument.

4.1 FREQUENCY SYNTHESIS CIRCUITS (Refer to Fig 4-1)

The TG-1 has three identical frequency synthesis boards: A1, A2 and A3. Each board synthesizes a tone by means of a digital counting process and each board has two inputs. One input is the system clock (fo) which is the basic signal source for the derivation of the output tone. It provides an input frequency of 1.98 MHz. The other input is a set of binary coded decimal (BCD) lines (8, 4, 2, 1). These lines determine the output frequency of the synthesizer board and hence of the output tone. The output frequency is given by the equation:

$$f\ output = \frac{fo}{M}$$

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	00	RELEASE TO PRODUCTION	2-10-72	



-009	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± 3 PLACE ± ANGULAR ±
MATERIAL
FINISH
MODEL NO TG-1

CONTRACT NO.

	NAME	DATE
DRAWN	M.S.A. Ford	2/8/72
CHECK		2-07-72
ELEC ENGR		3-27-72
MECH ENGR		
APPROVED		

SINGER
ELECTRONIC PRODUCTS DIVISION
GERTSCH OPERATION, LOS ANGELES, CALIF.

FREQUENCY SYNTHESIS BLOCK DIAGRAM

SIZE	CODE IDENT NO.	DWG NO.
D	88869	4-501252-001

SCALE | SHEET OF

DO NOT SCALE DRAWING

*ES: UNLESS OTHERWISE SPECIFIED

4-501252

where M = BCD scale factor. These two inputs control the decade rate scalers (DRS) consisting of AR1 - AR5 on each of the three frequency synthesizer boards A1, A2 and A3. The output from the DRS is applied to a serial-input, digital-to-analog (D/A) converter. This D/A converter consists of an up/down counter (AR7 - AR8) and a BCD ladder network (R4 - R18). The output voltage of the D/A converter represents a staircase signal, each step being proportional to the number of input pulses received from the DRS. When the up/down counter reaches maximum count, the up/down control circuits (AR9/AR10) switch the counter from up to down counting. When the counter reaches zero, the up/down control commands it to reverse itself and count upwards. Thus the output of the D/A converter is a positive staircase triangular waveform.

This positive triangular waveform is applied to negative-biased input amplifier AR11. The output of this amplifier is a symmetrical triangular function. The triangle waveform is further converted into a sinewave through triangle-to-sine converter Q1.

4.1.1 Multiplexing

Frequency synthesizer boards A1 and A3 are capable of receiving two frequency selections by means of a multiplexer. A3 frequency synthesizer board can receive f1 or f2 frequency control lines from the thumbwheel switches through multiplexer AR6 - AR10. A1 frequency synthesizer board can receive f3 or f4 frequency control lines from the thumbwheel switches through multiplexer AR1 - AR5. A2 frequency synthesizer board does not have a multiplexing input. Each frequency board also has one enable input which is used in mode selection. A3 frequency synthesizer board is enabled at all times.

4.1.2 Output

The output of each frequency board has a fixed gain determined by amplifier AR11. Provision is made for adjusting the gain of each frequency (f1, f2, f'2, f3 and f4). This can be done through potentiometers R1 - R5 located on the carrier board A4 and accessible via the rear panel. The signal then goes to solid state switch AR18, which is controlled with timing control lines $\overline{SO}$ and $\overline{S1}$. The output of AR18 is connected to the input of A4AR11. When $\overline{S0}$ and $\overline{S1}$ control lines select frequency f1 to go through the multiplexer and control A3 frequency synthesizer board,

at the same time control lines $\overline{S0}$ and $\overline{S1}$ will turn on the gate connected to potentiometer R3. The second gate connected to potentiometer R4 will be open. Therefore the position of R3 will determine the output of amplifier A4AR11. If f2 frequency is selected, the second gate will be closed and the first open. Potentiometer R4 will then determine the output of the amplifier. In other words, the solid state switch serves as a demultiplexer to allow a different gain for each selected frequency.

The output of A2 frequency synthesizer board (f'2) can be adjusted with potentiometer A4R5. Potentiometers R102, R103 and R104 are used internally for calibration purposes only.

Overall level control is adjusted through front panel potentiometer LEVEL control (R5).

4.2 CONTROL LOGIC CIRCUITS

Control logic circuits are used to perform the following functions:

a. To generate timing for bursts, pause and repeat delay. (Multiplexing and demultiplexing through lines $\overline{S0}$ and $\overline{S1}$).

b. To select mode of operation.

c. To determine single or repeat operation.

d. To perform the start function.

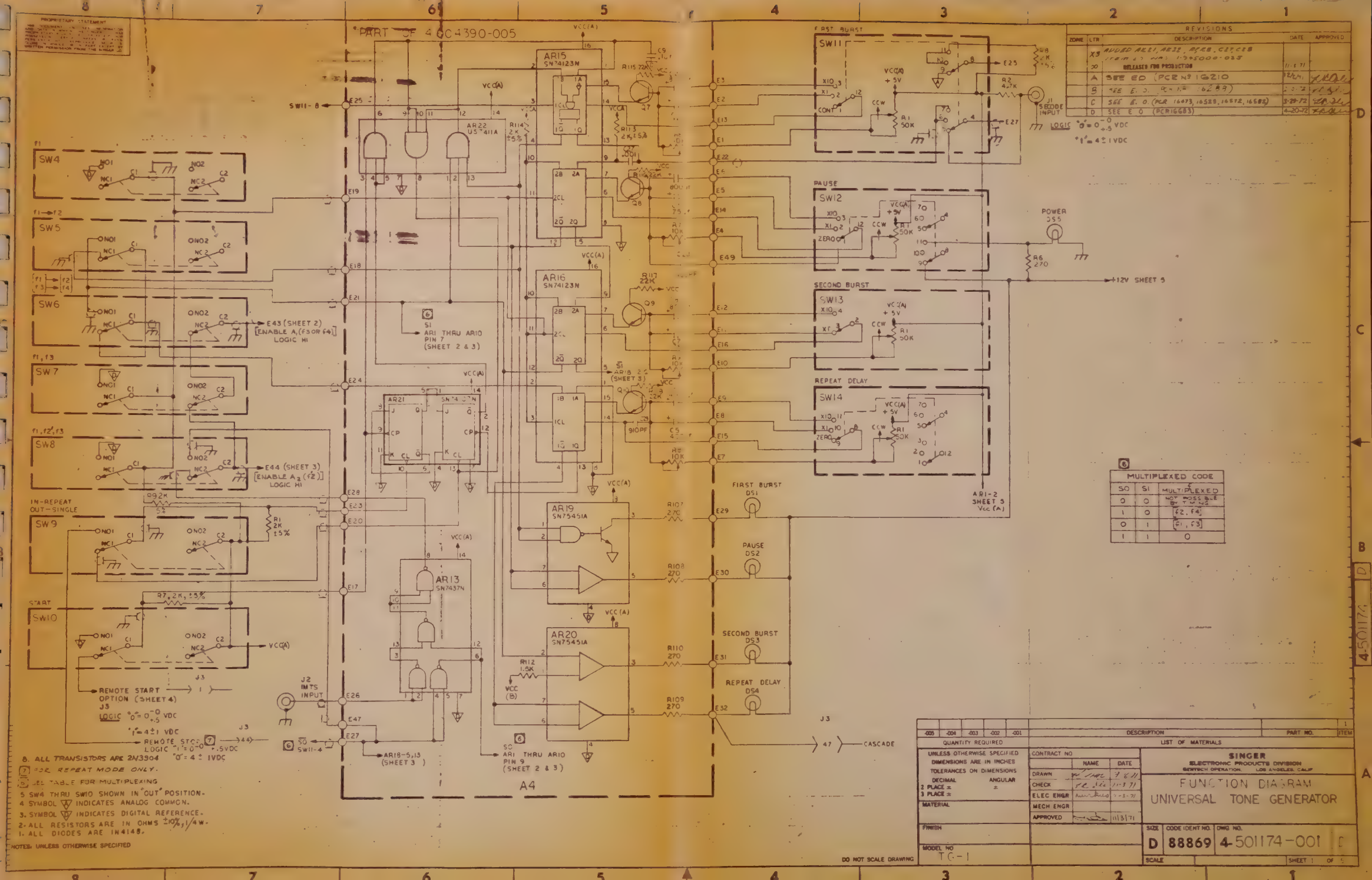
e. To provide buffering for indicator lights.

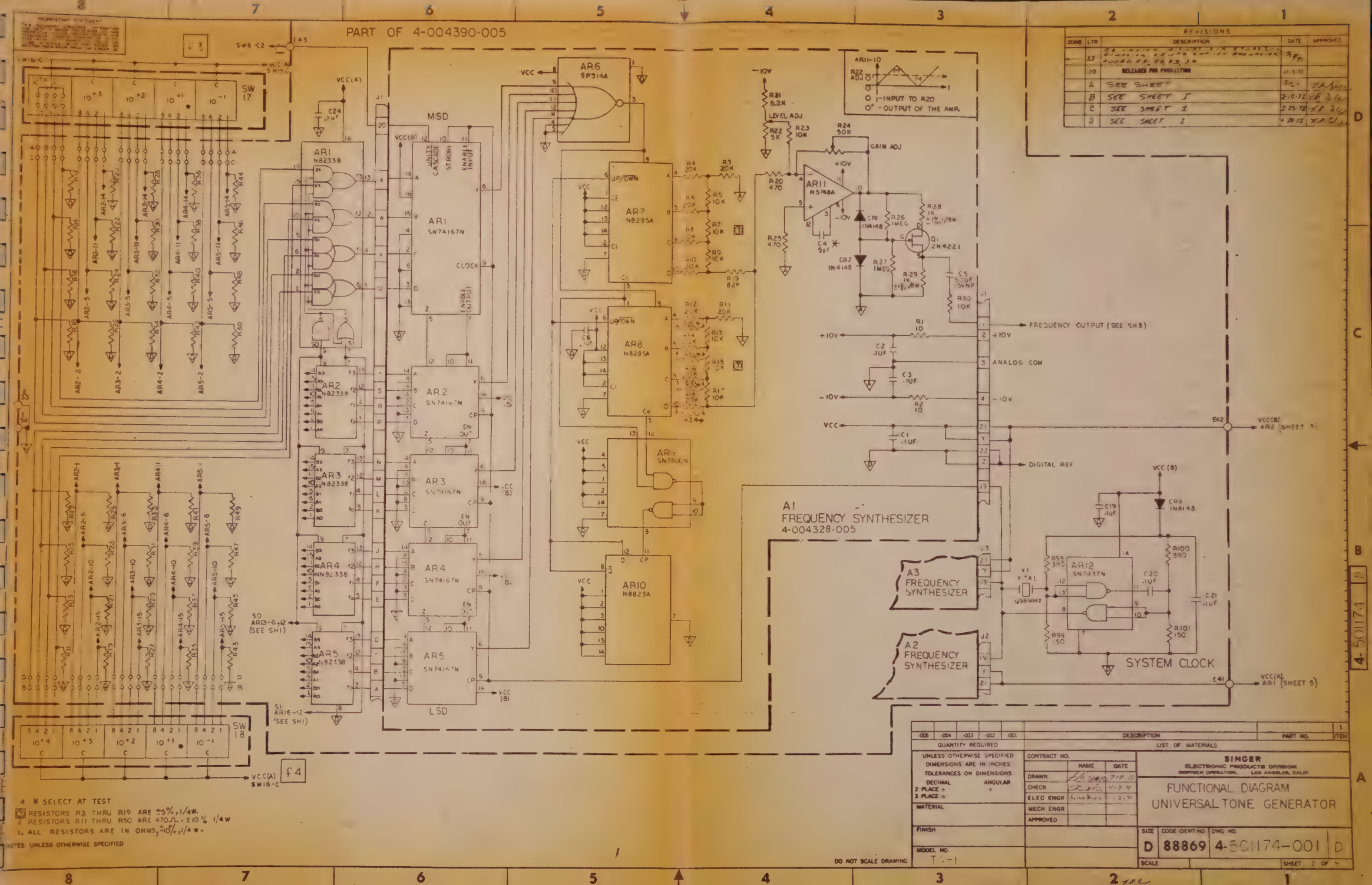
4.2.1 Timing Circuits

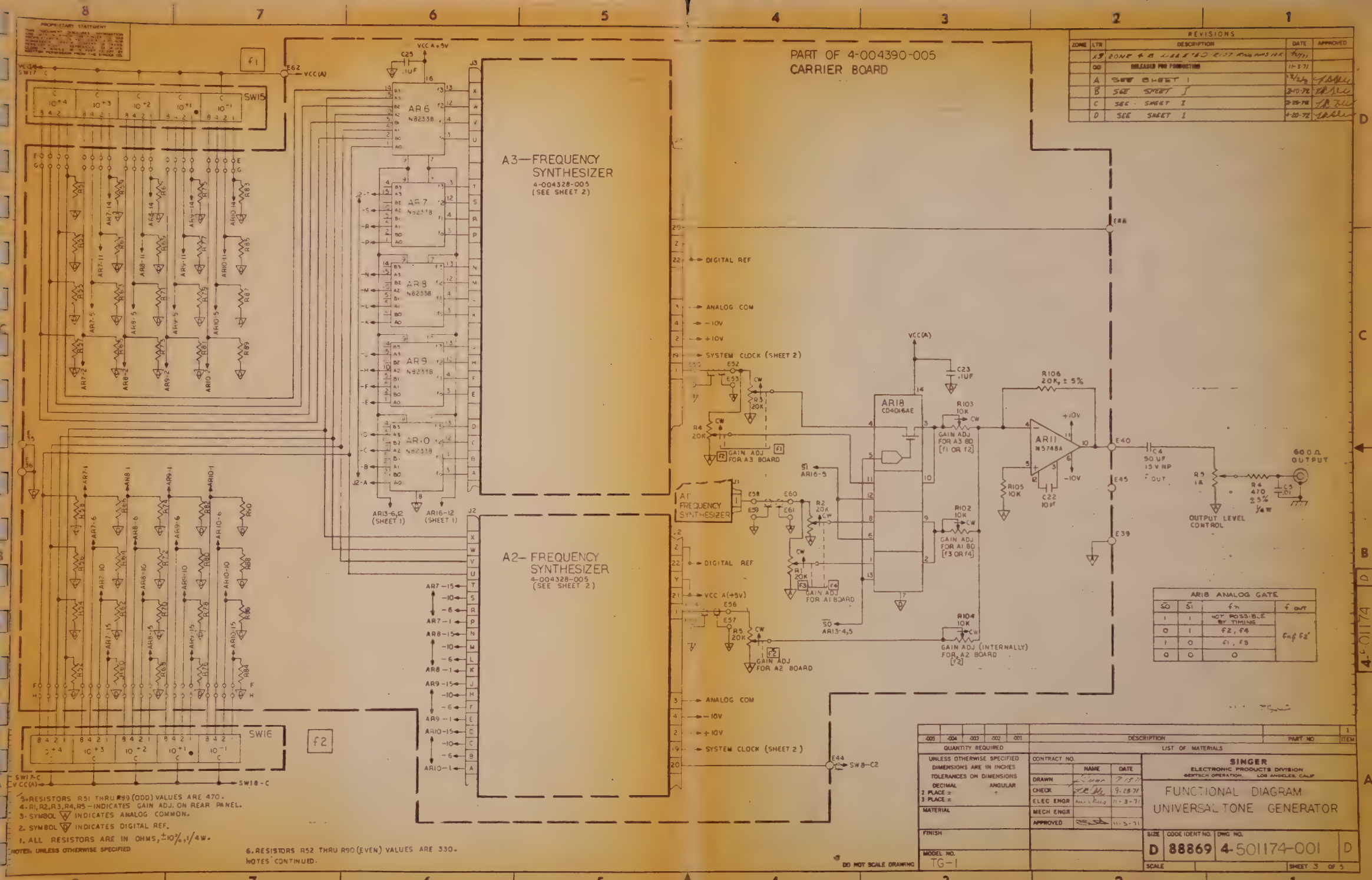
Each of the functions first burst, pause, second burst and repeat delay has a separate timing circuit (on chips AR15 and AR16). Time durations are controlled by front panel controls SW11, SW12, SW13, SW14. All four timing circuits are connected sequentially. Each one activates the following delay circuit at the completion of its own timing cycle. Some timing can be by-passed, depending on the mode selected. The timing circuits also drive the indicator lights through buffers AR19 and AR20.

4.2.2 Modes of Operation

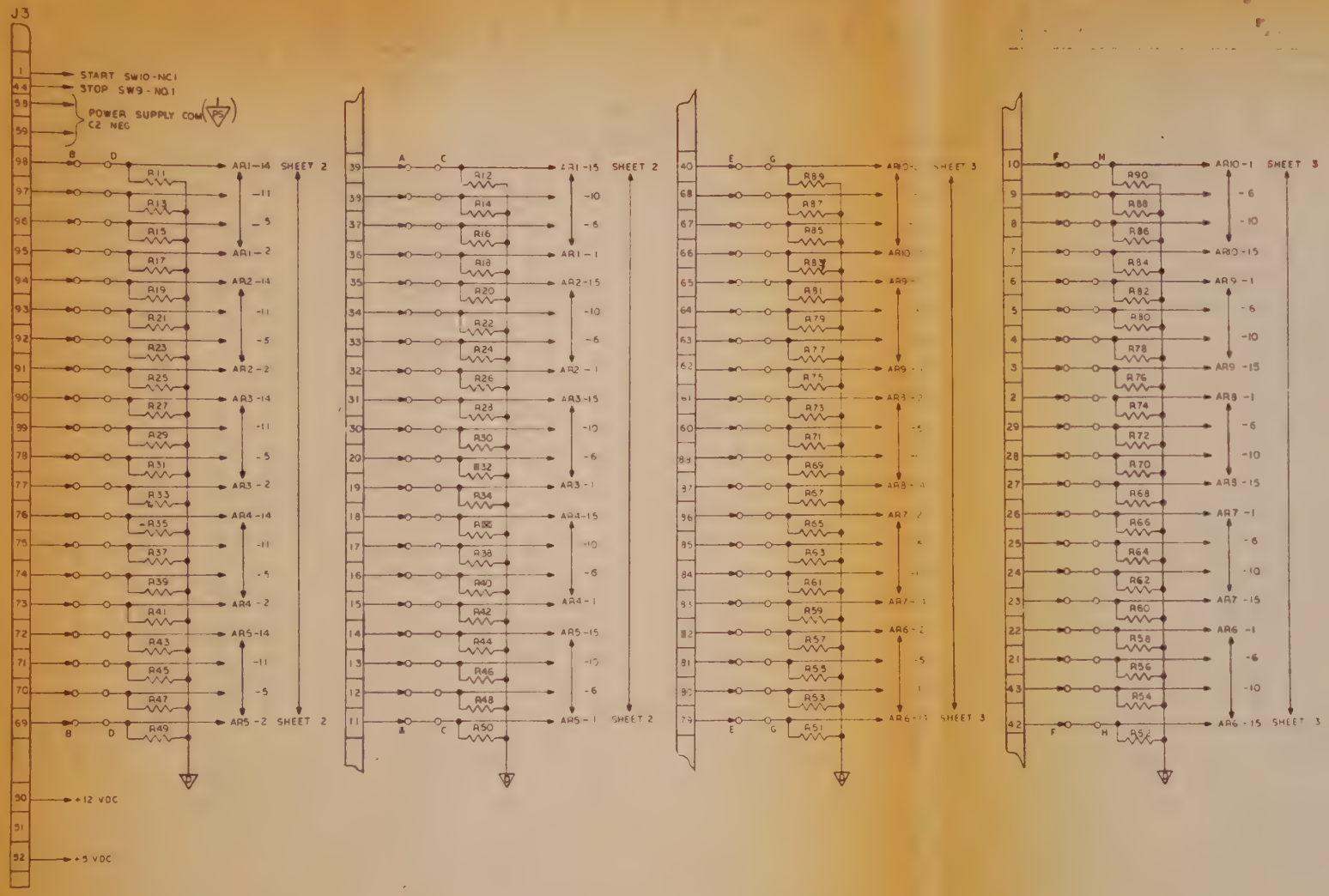
The mode-selection push-button switches and timing circuits are interconnected in such a way as to perform the desired functions. For example: If mode f1, f'2, f3 is selected, the circuit enables A1, A2, and A3 frequency synthesizer boards and allows the first burst to be generated (f1, f'2, f3). The second burst circuit is by-passed and therefore disabled.


PART OF 4CC4390-005
AR15 SN74123N
AR16 SN74123N
AR22 US*411A
AR21 SN74107N
AR19 SN7545IA
AR20 SN7545IA
AR13 SN7437N
SW4
SW5
SW6
SW7
SW8
SW9
SW10
SW11
SW12
SW13
SW14
FIRST BURST
PAUSE
SECOND BURST
REPEAT DELAY
IN-REPEAT
OUT-SINGLE
START
POWER
DS5
DS1
DS2
DS3
DS4
J1 SCODE INPUT
J2 IMTS INPUT
J3
+12V SHEET 5
E43 (SHEET 2) [ENABLE A1 (f3 OR f4)] LOGIC HI
E44 (SHEET 3) [ENABLE A2 (f2)] LOGIC HI
REMOTE START OPTION (SHEET 4)
REMOTE STOP
CASCADE
ARI-2 SHEET 5 Vcc (A)
AR18-5,13 (SHEET 3)
S1 ARI THRU AR10 PIN 7 (SHEET 2 & 3)
S0 ARI THRU AR10 PIN 9 (SHEET 2 & 3)
S0 SW11-4
SW11-8
MULTIPLEXED CODE
S0 S1 MULTIPLEXED
0 0 NOT POSSIBLE BY TWG
1 0 f2, f4
0 1 f1, f3
1 1 0
REVISIONS
ZONE LTR DESCRIPTION DATE APPROVED
X3 ADDED AR21, AR22, R114, C27, C28 FROM L.O. NO. 1-3500-035
X0 RELEASED FOR PRODUCTION 11-8-71
A SEE ED (PCR Nº 16210) 1-24-72
B SEE E.O. PCR Nº 16249 2-2-72
C SEE E.O. (PCR 16473, 16528, 16572, 16582) 3-29-72
D SEE E.O. (PCR16683) 4-20-72
A. ALL TRANSISTORS ARE 2N3904
B. FOR REPEAT MODE ONLY.
C. SEE TABLE FOR MULTIPLEXING
5 SW4 THRU SW10 SHOWN IN "OUT" POSITION.
4 SYMBOL INDICATES ANALOG COMMON.
3. SYMBOL INDICATES DIGITAL REFERENCE.
2. ALL RESISTORS ARE IN OHMS ±10%, 1/4W.
1. ALL DIODES ARE IN4148.
NOTES: UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DRAWING
LIST OF MATERIALS
SINGER ELECTRONIC PRODUCTS DIVISION SUNNYVALE OPERATION LOS ANGELES, CALIF.
FUNCTION DIAGRAM
UNIVERSAL TONE GENERATOR
SIZE D CODE IDENT NO. 88869 DWG NO. 4-501174-001
SCALE SHEET 1 OF 5
MODEL NO TG-1
A4


PART OF 4-004390-005
REVISIONS
ZONE LTR DESCRIPTION DATE APPROVED
20 RELEASED FOR PRODUCTION 11-3-71
A SEE SHEET
B SEE SHEET 1
C SEE SHEET 1
D SEE SHEET 1
MSD
LSD
AR1 SN74167N
AR2 SN74167N
AR3 SN74167N
AR4 SN74167N
AR5 SN74167N
AR6 SP314A
AR7 N8285A
AR8 N8285A
AR10 N8823A
AR11 N5748A
AR12 SN74S74N
A1 FREQUENCY SYNTHESIZER 4-004328-005
A3 FREQUENCY SYNTHESIZER
A2 FREQUENCY SYNTHESIZER
SW 17
SW 18
FREQUENCY OUTPUT (SEE SH3)
+10V
ANALOG COM
-10V
DIGITAL REF
SYSTEM CLOCK
1.998 MHZ
GAIN ADJ
LEVEL ADJ
1 = INPUT TO R20
0° = OUTPUT OF THE AMP.
4 * SELECT AT TEST
RESISTORS R3 THRU R19 ARE ±5%, 1/4W.
RESISTORS R11 THRU R50 ARE 470Ω ± 10% 1/4W
ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.
NOTES: UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DRAWING
LIST OF MATERIALS
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± 3 PLACE ±
ANGULAR ±
MATERIAL
FINISH
MODEL NO. T-1
CONTRACT NO.
DRAWN
CHECK
ELEC ENGR
MECH ENGR
APPROVED
SINGER
ELECTRONIC PRODUCTS DIVISION
FUNCTIONAL DIAGRAM
UNIVERSAL TONE GENERATOR
SIZE D
CODE IDENT NO 88869
DWG NO. 4-501174-001 D
SCALE
SHEET 2 OF 5
4-501174 D


PART OF 4-004390-005
CARRIER BOARD
A3—FREQUENCY SYNTHESIZER
4-004328-005
(SEE SHEET 2)
A2— FREQUENCY SYNTHESIZER
4-004328-005
(SEE SHEET 2)
A1 FREQUENCY SYNTHESIZER
AR18 CD4016AE
AR11 N5748A
SW1-C
SW1-B
SW1-A
DIGITAL REF
ANALOG COM
-10V
+10V
SYSTEM CLOCK (SHEET 2)
VCC A(+5V)
VCC(A)
GAIN ADJ FOR A3 BOARD
GAIN ADJ FOR A2 BOARD
GAIN ADJ FOR A1 BOARD
GAIN ADJ (INTERNALLY) FOR A2 BOARD
GAIN ADJ FOR A3 BD (f1 OR f2)
GAIN ADJ FOR A1 BD (f3 OR f4)
OUTPUT LEVEL CONTROL
600Ω OUTPUT
AR13-6,12 (SHEET 1)
AR16-12 (SHEET 1)
AR13-4,5
AR16-5
R106 20K, ± 5%
C4 50 UF 15 V NP
C22 10PF
C23 .1UF
C25 .1UF
R4 470 ± 5% 1/4W
C3 .01
R5 1K
AR18 ANALOG GATE
S0 S1 fn f out
0 0 0
0 1 f2, f4
1 0 f1, f3
1 1 NOT POSSIBLE BY TIMING
f out = f2'
1. ALL RESISTORS ARE IN OHMS, ±10%, 1/4W.
2. SYMBOL ▽ INDICATES DIGITAL REF.
3. SYMBOL ▽ INDICATES ANALOG COMMON.
4. R1, R2, R3, R4, R5 — INDICATES GAIN ADJ. ON REAR PANEL.
5. RESISTORS R51 THRU R99 (ODD) VALUES ARE 470.
6. RESISTORS R52 THRU R90 (EVEN) VALUES ARE 330.
NOTES: UNLESS OTHERWISE SPECIFIED
NOTES CONTINUED.
DO NOT SCALE DRAWING
REVISIONS
ZONE LTR DESCRIPTION DATE APPROVED
RELEASED FOR PRODUCTION 11-3-71
A SEE SHEET 1 3/22/72
B SEE SHEET 1 2-10-72
C SEE SHEET 1 3-28-72
D SEE SHEET 1 4-20-72
LIST OF MATERIALS
QUANTITY REQUIRED -005 -004 -003 -002 -001
DESCRIPTION PART NO. ITEM
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL 2 PLACE ± 3 PLACE ±
ANGULAR ±
MATERIAL
FINISH
MODEL NO. TG-1
CONTRACT NO.
NAME DATE
DRAWN 9-28-71
CHECK 9-28-71
ELEC ENGR 11-3-71
MECH ENGR
APPROVED 11-3-71
SINGER
ELECTRONIC PRODUCTS DIVISION
GEOTECH OPERATION, LOS ANGELES, CALIF.
FUNCTIONAL DIAGRAM
UNIVERSAL TONE GENERATOR
SIZE D
CODE IDENT NO. 88869
DWG NO. 4-501174-001 D
SCALE
SHEET 3 OF 5
4-01174 D

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	00	RELEASE TO PRODUCTION	11-1-71	
	A	SEE SHEET 1	1/4/72	
	B	SEE SHEET 1	2-10-72	
	C	SEE SHEET 1	2-23-72	
	D	SEE SHEET 1	4-20-72	



3 FOR RESISTOR VALUE SEE SHEETS 2 AND 3.
2. SYMBOL (V) INDICATES DIGITAL REFERENCE.
1. SYMBOL (PS) INDICATES POWER SUPPLY.

NOTES: UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING

-005	-004	-003	-002	-001	DESCRIPTION	PART NO.	ITEM
QUANTITY REQUIRED					LIST OF MATERIALS		

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DIMENSIONS
DECIMAL ANGULAR
2 PLACE ± ±
3 PLACE ±
MATERIAL
FINISH
MODEL NO. TG-1

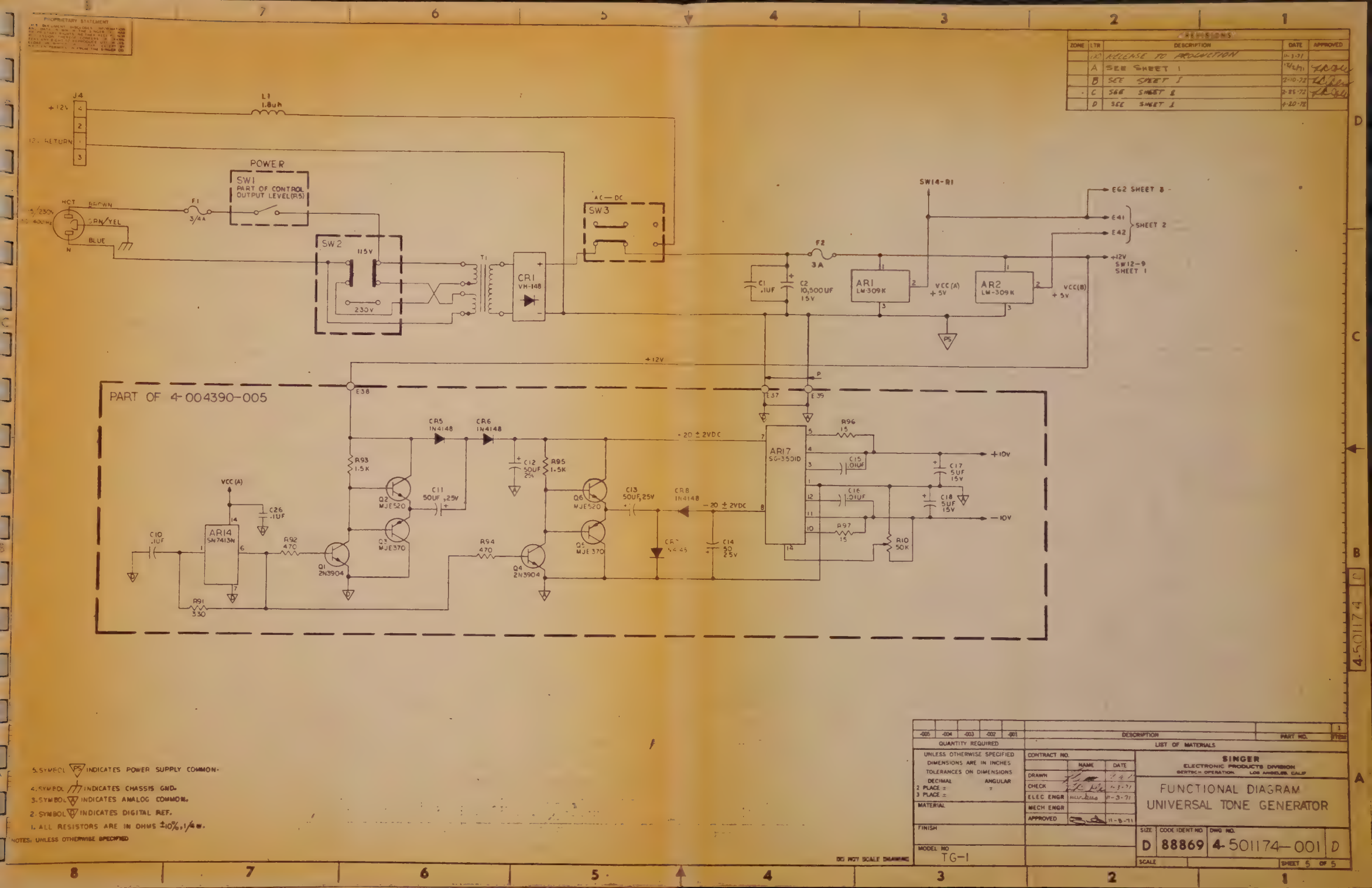
	NAME	DATE
CONTRACT NO.		
DRAWN	[illegible]	9 2 71
CHECK	[illegible]	11-3-71
ELEC ENGR	[illegible]	1-3-71
MECH ENGR		
APPROVED	[illegible]	1-3-71

SINGER
ELECTRONIC PRODUCTS DIVISION
GEARTECH OPERATION, LOS ANGELES, CALIF.

FUNCTIONAL DIAGRAM
UNIVERSAL TONE GENERATOR

SIZE	CODE IDENT NO	DWG NO.	
D	88869	4-501174-001	D
SCALE		SHEET 4 OF 5	

4-501174 D


PROPRIETARY STATEMENT
REVISIONS
ZONE | LTR | DESCRIPTION | DATE | APPROVED
LTR | RELEASE TO PRODUCTION | 11-3-71
A | SEE SHEET 1 | 1-14-72
B | SEE SHEET 1 | 2-10-72
C | SEE SHEET 1 | 2-25-72
D | SEE SHEET 1 | 4-20-72
J4
+12V
12V RETURN
L1 1.8uh
POWER
SW1 PART OF CONTROL OUTPUT LEVEL(RS)
HOT BROWN
GRN/YEL
BLUE
N
F1 3/4A
SW2
115V
230V
T1
CR1 VM-148
AC — DC
SW3
SW14-R1
EG2 SHEET 8
E41
E42
SHEET 2
+12V SW12-9 SHEET 1
F2 3A
C1 .1UF
C2 10,500UF 15V
AR1 LM-309K
VCC(A) +5V
AR2 LM-309K
VCC(B) +5V
PS
+12V
P
PART OF 4-004390-005
E36
E37
E39
CR5 IN4148
CR6 IN4148
+20 ± 2VDC
R93 1.5K
C12 50UF 25V
R95 1.5K
Q2 MJE520
Q3 MJE370
C11 50UF 25V
Q6 MJE520
Q5 MJE370
C13 50UF 25V
CR8 IN4148
-20 ± 2VDC
CR7 IN4445
C14 50 25V
AR17 SG-3501D
R96 15
C15 .01UF
C16 .01UF
R97 15
R10 50K
C17 5UF 15V
C18 5UF 15V
+10V
-10V
VCC(A)
C26 .1UF
C10 .1UF
AR14 SN7413N
R92 470
R94 470
Q1 2N3904
Q4 2N3904
R91 330
5. SYMBOL PS INDICATES POWER SUPPLY COMMON.
4. SYMBOL INDICATES CHASSIS GND.
3. SYMBOL INDICATES ANALOG COMMON.
2. SYMBOL INDICATES DIGITAL REF.
1. ALL RESISTORS ARE IN OHMS ±10%, 1/4W.
NOTES: UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DRAWING
-005 -004 -003 -002 -001
QUANTITY REQUIRED
DESCRIPTION
PART NO.
ITEM
LIST OF MATERIALS
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON DIMENSIONS DECIMAL 2 PLACE ± 3 PLACE ± ANGULAR ±
MATERIAL
FINISH
MODEL NO TG-1
CONTRACT NO.
NAME DATE
DRAWN
CHECK 11-3-71
ELEC ENGR 11-3-71
MECH ENGR
APPROVED 11-8-71
SINGER
ELECTRONIC PRODUCTS DIVISION
GERTSCH OPERATION LOS ANGELES, CALIF
FUNCTIONAL DIAGRAM
UNIVERSAL TONE GENERATOR
SIZE D
CODE IDENT NO 88869
DWG NO. 4-501174-001
REV D
SCALE
SHEET 5 OF 5
4-501174 D

4.2.3 Repeat Cycling Circuits

The control logic cycling circuit determines when the first burst should be initiated again in the automatic repeat mode. The trailing edge of the repeat delay pulse from timing circuit AR16 initiates the first burst in the repeat mode or stops cycling in the single cycle mode. (Time for one cycle = first burst time + pause time + second burst time + repeat delay time).

4.2.4 Start Circuit

This circuit (AR22) initiates the first burst timing cycle when pushbutton START is pressed. The START can be performed remotely. The START function is also available on the rear connector (J3) (T^2L compatible).

4.2.5 Stop Circuit

This circuit is part of START/STOP circuit (AR21, AR22). To stop cycling in the repeat mode push-out REPEAT/SINGLE pushbutton. On programmable units, the stop function is also available on the rear connector (J3).

SECTION V

MAINTENANCE

5.1 INTRODUCTION

The Universal Tone Generator Model TG-1 is calibrated at the factory and requires recalibration every six months. Procedures are given in this section for adjusting the distortion of the frequency synthesizer boards, adjusting the timing circuits and adjusting the power supply. All three frequency synthesizer boards are identical but will require realignment if they are removed and re-installed in different connectors. They are calibrated at the factory for minimum distortion.

5.2 TEST EQUIPMENT

The following instruments are required for calibration checking and re-alignment:

a. Oscilloscope, Tektronix Model 543B or equivalent.

b. Resistor decade box, (100-500K).

c. Distortion meter, HP331A, or equivalent.

d. 44 pin extender board Singer (4-103189-001), or equivalent (opti

e. Voltmeter, Triplett 630-A or equivalent.

f. Counter, HP 5532A or equivalent.

5.3 POWER SUPPLY ADJUSTMENT

Only the +10 VDC supply should be adjusted. The -10 VDC is adjusted automatically by adjustment of the +10 VDC supply. Connect the voltmeter to AR17-4 on Carrier Board A4 and check that the voltage is +10 VDC. If it is not, adjust potentiometer R10.

5.4 TEST AND ADJUSTMENT PROCEDURES FOR FREQUENCY SYNTHESIZER BOARDS

5.4.1 Frequency Synthesizer Board, A1

5.4.1.1 Triangularity Check

a. Install extender board (if available) in place of A1 and connect A1 into the extender.

b. Turn on power to the TG-1 and set LEVEL control at max CW.

c. Push MODE switch f1, f3 to IN position.

d. Turn FIRST BURST switch to CONT.

e. Connect scope probe to output of amplifier AR11-10 or R28.

f. Set thumbwheel f3 to 9000.0 Hz.

g. The output should be triangular as shown in Figure 5-1. If the waveform is broken as shown in Figure 5-2, the digital-to-analog converter is not functioning uniformly for all bits, and the following adjustment procedure should be performed.

5.4.1.2 Triangularity Adjustment Procedure

The following procedure is intended to correct the type of break illustrated in Figure 5-2. While other break points are possible, a fault is most likely to appear at the point shown. The numbers shown in Figure 5-2 correspond to the bit weight of the most significant decade. Bit 8 is the most significant bit in an 8, 4, 2, 1 BCD code. For this reason a fault is most likely to be evident at point 8 and bit 8 is most likely to have a negative error, as shown. To bring bit 8 back to its proper value so that the waveform follows the broken line, the effective resistance across R18 and R34, which are in parallel must be reduced.

To do this:

a. Remove R34.

b. Connect a decade resistance box across R18.

c. Adjust the resistance box until a good triangular wave is obtained.

d. Select a standard resistor closest in value to the setting of the resistance box and solder it in place of R34.

e. Proceed to the following distortion test and adjustment procedure.

5.4.1.3 Distortion Check and Adjustment

a. Connect the distortion meter to the TG-1 output.

b. Set thumbwheel f3 to 9000.0 Hz.

c. Set distortion meter frequency range to X1K position.

d. Connect oscilloscope to distortion meter output.

e. Obtain a display of the distortion meter output on the oscilloscope and observe that it is sinusoidal. If it is not, adjust potentiometers R22 and R24 on A1 as follows until the waveform is sinusoidal.

f. If the distortion meter reading is greater than 5%, adjust R22 for minimum distortion then adjust R24 for minimum distortion. (Check the distortion analyzer input level).

g. Adjust R22 for minimum distortion and then R24.

h. Repeat step g until distortion is less than 5% (typical value 2.5%).

i. Using the oscilloscope, adjust R103 on the Carrier Board A4 for an output level of 1.1 $\pm$2%V rms. (approx. 3V p-p).

5.4.2 Frequency Synthesizer Board, A2

a. Repeat steps 5.4.1.1 a through g except use MODE f1, f'2, f3 at step c and set thumbwheel f2 to 9000.0 Hz at step f.

b. Repeat steps 5.4.1.2 a through e and steps 5.4.1.3 a through i except adjust R104 at step i.

5.4.3 Frequency Synthesizer Board, A3

a. Repeat steps 5.4.1.1 a through e except use MODE f1 at step c and set thumbwheel f1 to 9000.0 Hz at step f.

b. Repeat steps 5.4.1.2 a through e and steps 5.4.1.3 a through i except adjust R102 at step i.

5.5 TIMING CHECK AND ADJUSTMENT PROCEDURES

5.5.1 First Burst (set pause, second burst, and repeat delay to minimum)

a. Push IN-REPEAT/OUT-SINGLE switch to IN position.

b. Push MODE switch f1⟶f2 to IN position.

c. Push START switch to begin cycling.

d. Turn FIRST BURST switch to X1 position.

e. Turn FIRST BURST potentiometer to max CCW position.

f. Connect scope probe to terminal E18 (amp terminal) on front of Carrier Board A4.

g. Obtain oscilloscope display of timing pulse. The duration of the pulse which goes down to the reference voltage (OV) should be 0.1 second. If it is not, adjust R6 on A4.

h. Turn FIRST BURST potentiometer to max CW position.

i. Observe that the pulse which goes down to reference voltage (OV) is 1.0 ±20% second. If the pulse length is shorter than 0.8 seconds, replace capacitor C1 on A4. If the pulse length is longer than 1.2 seconds, add a resistor across potentiometer R1 (on SW11) of such a value that it will shorten the pulse to within the specified timing range.

j. Turn FIRST BURST switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (OV) is 10 ±20% sec. If the pulse is shorter than 8.0 seconds, replace capacitor C2 on A4. If the pulse is longer than 12 seconds, add a resistor across potentiometer R1 on SW11 of such a value that it will shorten the pulse to within the specified timing range.

5.5.2 Pause

a. Push IN-REPEAT/OUT-SINGLE switch to IN position.

b. Push MODE switch f1——→f2 to in position.

c. Push START switch.

d. Turn PAUSE switch to X1 position.

e. Turn PAUSE potentiometer to max CCW position.

f. Connect scope probe to terminal E30 on Carrier Board A4.

g. Obtain oscilloscope display of timing pulse. The duration of the pulse which goes down to the reference voltage (OV) should be 0.1 seconds. If it is not, adjust R7 on A4.

h. Turn PAUSE potentiometer to max CW position.

i. Observe that the pulse which goes down to reference voltage (OV) is 1.0 $\pm$20% seconds. If the pulse length is shorter than 0.8 seconds, replace capacitor C3 on A4. If the pulse length is longer than 1.2 seconds, add a resistor across potentiometer R1 on SW12 of such a value that it will shorten the pulse to within the specified timing range.

j. Turn PAUSE switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (OV) is 10 $\pm$20% seconds. If the pulse is shorter than 8.0 seconds, replace capacitor C4 on A4. If the pulse is longer than 12.0 seconds, add a resistor across potentiometer R1 on SW12 of such a value that it will shorten the pulse to within the specified timing range.

5.5.3 Second Burst

a. Push IN-REPEAT/OUT-SINGLE switch to IN position.

b. Push MODE switch f1——→f2 to IN position.

c. Push START switch.

d. Turn SECOND BURST switch to X1 position.

e. Turn SECOND BURST potentiometer to max CCW position.

f. Connect scope probe to terminal E21 on A4.

g. Obtain oscilloscope display of timing pulse. The duration of the pulse which goes down to reference voltage (OV) should be 0.1 seconds. If it is not, adjust R9 on A4.

h. Turn SECOND BURST potentiometer to max CW position.

i. Observe that the pulse which goes down to reference voltage (OV) is 1.0 ±20% seconds. If the pulse length is shorter than 0.8 seconds, replace capacitor C7 on A4. If the pulse length is longer than 1.2 seconds, add a resistor across potentiometer R1 on SW13 of such a value that it will shorten the pulse to within the specified timing range.

j. Turn SECOND BURST switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (OV) is 10 ±20% seconds. If the pulse is shorter than 8.0 seconds, replace capacitor C8 on A4. If the pulse length is longer than 12.0 seconds, add a resistor across R1 on SW13 of such a value that it will shorten the pulse to within the specified timing range.

5.5.4 Repeat Delay

a. Push IN-REPEAT/OUT-SINGLE switch to IN position.

b. Push MODE switch f1⟶f2 to IN position.

c. Push START switch.

d. Turn REPEAT DELAY switch to X1 position.

e. Turn REPEAT DELAY potentiometer to max CCW position.

f. Connect scope probe to terminal E32 on A4.

g. Obtain scope display of timing pulse. The duration of the pulse which goes down to reference voltage (OV) should be 0.5 seconds. If it is not, adjust R8 on A4.

h. Turn REPEAT DELAY potentiometer to max CW position.

i. Observe that the pulse which goes down to reference voltage (OV) is 5 ±20% seconds. If the pulse length is shorter than 4.0 seconds, replace capacitor C5 on A4. If the pulse length is longer than 6.0 seconds, add a resistor across potentiometer R1 on SW14 of such a value that it will shorten the pulse to within the specified timing range.

j. Turn REPEAT DELAY switch to X10 position.

k. Observe that the pulse which goes down to reference voltage (OV) is 50 ±20% seconds. If the pulse is shorter than 40 seconds, replace capacitor C6 on A4. If the pulse is longer than 60 seconds, add a resistor across R1 on SW14 of such a value that it will shorten the pulse to within the specified timing range.

5.6 FREQUENCY ACCURACY TEST

5.6.1 Frequency f1 Test (all models)

a. Connect output of TG-1 to electronic counter.

b. Set the output level of TG-1 to maximum CW position.

c. Select mode f1.

d. Set the thumbwheel switch f1 (SW15) to 7777.7 Hz.

e. Put the timing switch (SW11) of first burst to CONT position.

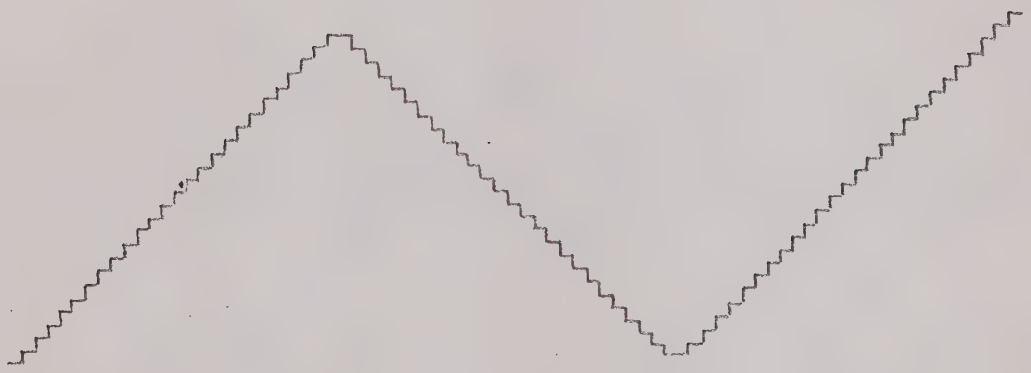


Fig 5-1 Correct Triangular Output Waveform

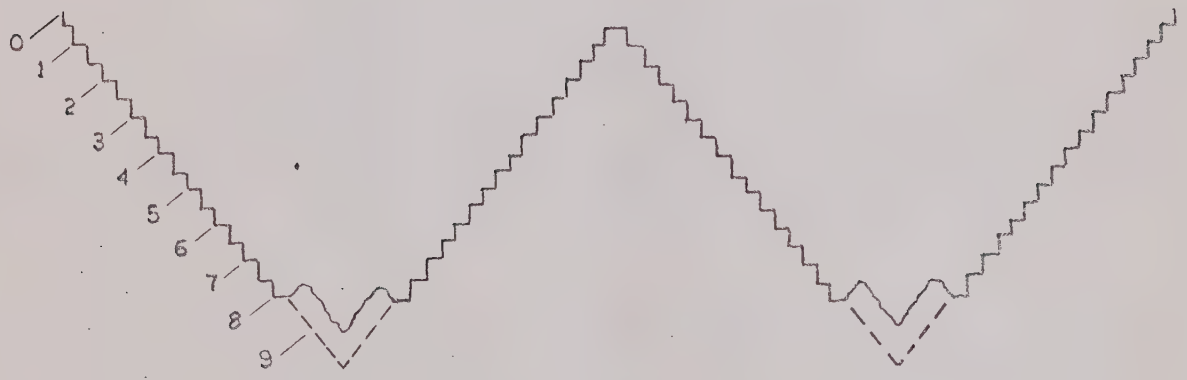


Fig 5-2 Incorrect Output Waveform

f. Set the function switch of electronic counter to FREQUENCY 10 KHz.

g. Set the sensitivity of electronic counter to 1.0 position.

h. Reset the counter.

i. Reading should be 07.7777 ±0.0001 kHz.

j. Set the thumbwheel switch f1 (SW15) to 8888.8 Hz.

k. Reset the counter.

l. Reading should be 08.8888 ±00.0001 kHz.

5.6.2 Frequency f2 Test (TG-1B, and TG-1C only)

a. Connect output of TG-1 to electronic counter.

b. Set the output level of TG-1 to maximum CW position.

c. Select mode f1 ⟶ f2.

d. Push button (SW9) switch to IN position.

e. Set the thumbwheel switch f2 (SW16) to 7777.7 Hz. (All other thumbwheels in zero position).

f. Set the timing switch of FIRST BURST (SW11) to X1 position, and potentiometer R1 to the middle position.

g. Set the timing switch of PAUSE (SW12) to ZERO position.

h. Set the timing switch of SECOND BURST (SW14) to X10 position, and potentiometer R1 to maximum CW position.

i. Set the timing switch of REPEAT DELAY (SW15) to ZERO position.

j. Set the function switch of electronic counter to FREQUENCY 10 kHz.

k. Set the sensitivity of electronic counter to 1.0 position.

l. Press START of TG-1. At the very beginning of SECOND BURST (light on) reset the counter.

m. Reading should be 07.7777 ±00.0001 kHz.

n. Set the thumbwheel switch f2 (SW16) to 8888.8 Hz.

o. Reading should be 08.8888 ±00.0001 kHz.

5.6.3 Frequency f3 Test (TG-1B, and TG-1C only)

The procedure for frequency accuracy test is similar to frequency f2 test given in paragraph 5.6.2 with the following exceptions:

a. Select MODE f1, f3.

b. Set the thumbwheel switch f3 (SW17) to 7777.7 Hz or 8888.8 Hz.

c. All other thumbwheel switches should be in zero position.

5.6.4 Frequency f4 Test (TG-1B, and TG-1C only)

a. Connect output of TG-1 to electronic counter.

b. Set the output level of TG-1 to maximum CW position.

c. Select MODE [f1 → f2 / f3 → f4]

d. Push button switch (SW9) to IN position.

e. Set the thumbwheel switch f4 (SW18) to 7777.7 Hz. (All other thumbwheels in zero position).

f. Set the timing switch of FIRST BURST (SW11) to X1 position, and potentiometer R1 to the middle position.

g. Set the timing switch of PAUSE (SW12) to ZERO position.

h. Set the timing switch of SECOND BURST (SW14) to X10 position, and potentiometer R1 to maximum CW position.

i. Set the timing switch of REPEAT DELAY (SW15) to ZERO position.

j. Set the function switch of electronic counter to FREQUENCY 10 kHz.

k. Set the sensitivity of electronic counter to 1.0 position.

l. Press START of TG-1. At the very beginning of SECOND BURST (light on) reset the counter.

m. Reading should be 07.7777 $\pm$00.0001 kHz.

n. Set the thumbwheel switch f4 (SW18) to 8888.8 Hz.

o. Reading should be 08.8888 $\pm$00.0001 kHz.

SECTION VI

INSTALLATION PROCEDURE FOR UPGRADING TG-1

6.1 INTRODUCTION

TG-1 can be upgraded in the field using factory prewired kits as follows:

FROM	TO	KIT NUMBER
TG-1A	TG-1B	1-004649-001
TG-1A	TG-1C	1-004650-001
TG-1B	TG-1C	4-004328-005
TG-1 (A, B or C)	TG-1 (A, B or C) P	1-004655-001

6.2 UPGRADING TG-1A TO TG-1B (KIT NO. 1-004649-001)

a. Five integrated circuits N8233B plug into the sockets A4AR1 - A4AR5 on the carrier board (A4).

b. Remove cover on the front panel for f3 thumbwheel switch.

c. Install prewired thumbwheel (harness no. 1).

d. Remove cover on the front panel for f4 thumbwheel switch.

e. Install prewired thumbwheel (harness no. 2).

f. The amp terminals from the wires should be plugged on the carrier board terminals as shown in figure 6-1.

g. Frequency synthesizer board (A1) (4-004328-005) plugs into the connector J1 on the carrier board (A4).

h. Perform calibration procedure described in paragraph 5.4.1.

6.3 UPGRADING TG-1A to TG-1C (KIT NO. 1-004650-001)

a. Same as 6.2 (a to g).

b. Frequency synthesizer board (A2) (4-004328-005) plugs into the connector J2 on the carrier board (A4).

c. Perform calibration procedure described in paragraphs 5.4.2 and 5.4.3.

6.4 UPGRADING TG-1B TO TG-1C (KIT NO. 4-004328-005)

a. Frequency synthesizer board (A2) (4-004328-005) plugs into the connector J2 on the carrier board (A4).

b. Perform calibration procedure described in paragraph 5.4.3.

6.5 UPGRADING TG-1A, B, OR C TO PROGRAMMABLE UNIT (KIT NO. 1-004655-001)

a. Remove cover on the rear panel for J3 connector.

b. Install prewired connector Amphenol 17-80980.

c. The amp terminals from the wires should be plugged onto the carrier board terminals as shown in figure 6-2.

d. Set all front panel thumbwheel switches to zero position.

e. Perform calibration procedure described in paragraph 5.6 using remote switches.

Fig 6-1 f3, f4 Thumbwheel Harness Connection Diagram

Fig 6-2 Programming Connector Harness Connection Diagram

TG-1, TONE GENERATOR, MAIN ASSEMBLIES, PARTS LIST

SYMBOL NUMBER	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
A1	Frequency Synthesizer Board	4-004328-005			
A2	Same as A1				
A3	Same as A1				
A4	Carrier Board	4-004390-005			

TG-1, TONE GENERATOR, MAINFRAME, PARTS LIST

SYMBOL NUMBER	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
AR1	Integrated circuit, +5 VDC regulator	1-926038-002	NS	LM-309K	
AR2	Same as AR1				
C1	Capacitor, met plastic 0.1 uf	1-900001-013	Amperex	X280AE	
C2	Capacitor, elec, 10,500 uf	1-900073-002	Mallory	CG1052015K1	
C3	Same as C1				
C4	Capacitor, elect, 50 uf, 15VNP	1-900060-001	GI	98416NP	
CR1	Diode bridge rect, epoxy	1-913040-001	Varo	VH148TT	
DS1	Indicator light (green)	1-925006-002	Mura	L-10/20	
DS2	Same as DS1				
DS3	Same as DS1				
DS4	Same as DS1				
DS5	Indicator light (red)	1-925007-003	Mura	L-10/20	

TG-1, TONE GENERATOR, MAINFRAME, PARTS LIST (contd)

SYMBOL NUMBER	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
F1	Fuse, 3/4A	1-924000-017	Bussmann	Type MDL	
F2	Fuse, 3A	1-924000-027	Bussmann	Type MDL	
J1	Jack, phone	1-910026-001	Switchcraft	Type 3C1054A	
J2	Same as J1				
J3	Connector, receptacle	1-910183-001	Amphenol	17-80980	
J4	Connector, plug	1-910179-002	Cinch Jones	P-304-DB	
L1	Choke, 1.8 uH	1-906009-001			
P1	Cord, power	1-910166-001	Belden	KH7375	
R1	Resistor, comp, 2K ±5%, 1/4W	1-945000-169	Allen Bradley	Typce CB	
R2	Resistor, comp, 4.7K ±10%, 1/4W	1-945000-045	Allen Bradley	Typce CB	
R3	Not used				
R4	Resistor, 470 ohms ±5%, 1/4W	1-945000-154	Allen Bradley	Type CB	

TG-1, TONE GENERATOR, MAINFRAME, PARTS LIST (contd)

SYMBOL NUMBER	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
R5	Resistor, variable 1K pot/switch (S1)	1-403343-001	Allen Bradley	Type CB	
R6	Resistor, comp 270 ohms ±10%, 1/4W	1-945000-030	Allen Bradley	Type CB	
R7	Same as R1				
R8	Same as R1				
S1	Switch/variable resistor (see R5)				
S2	Switch, slide (115/230)	1-951003-001	Switchcraft	Type 46206LF	
S3	Switch, slide (AC-DC)	1-951003-001	Switchcraft	Type 46206LF	
S4	Switch, pushbutton assembly	1-951020-002	IEE	TXF17.5FSB/BLK-2U-GR	
S5	Same as S4				
S6	Same as S4				
S7	Same as S4				
S8	Same as S4				
S9	Same as S4				
S10	Same as S4				

TG-1, TONE GENERATOR, MAINFRAME, PARTS LIST (contd)

SYMBOL NUMBER	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
S11	Switch, pot concentric	1-003407-004			
S12	Same as S11				
S13	Switch, pot concentric	1-003407-005			
S14	Same as S11				
T1	Transformer, power	1-403314-001			

TG-1, TONE GENERATOR, A1 FREQUENCY SYNTHESIZER, PARTS LIST

SYMBOL NUMBER	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
AR1	Integrated cct, decade rate scaler	1-926007-011	TI	SN74167N	
AR2	Same as AR1				
AR3	Same as AR1				
AR4	Same as AR1				
AR5	Same as AR1				
AR6	Integrated cct, 7-input nor gate	1-926018-003	Signetics	SP314A	
AR7	Integrated cct, decade up/$\overline{\text{dwn}}$ counter	1-926047-003	Signetics	N8285A	
AR8	Same as AR7				
AR9	Integrated cct, 2-input nand gate	1-926007-001	TI	SN7400N	
AR10	Integrated cct, D-input F.F.	1-926047-001	Signetics	N8828N	
AR11	Integrated cct, operational amplifier	1-926048-001	Signetics	N5748A	
C1	Capacitor, net plastics, 0.1 uf	1-900001-013	Amperex	C280AE	
C2	Same as C1				
C3	Same as C1				

TG-1, TONE GENERATOR, A1 FREQUENCY SYNTHESIZER, PARTS LIST (contd)

SYMBOL NUMBER	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
C4	Capacitor, dipped mica (5 AT) 5 pf	1-900003-004	EMM	DM15	
C5	Capacitor, elect, non-polar 50 uf, 15 v	1-900060-001	GI	984-16NP	
C6	Same as C1				
CR1	Diode	1-913007-002		iN4148	
CR2	Same as CR1				
Q1	Transistor, field effect	1-958052-001	Motorola	2N4221	
R1	Resistor, comp, 10 ohm ±10%, 1/4W	1-945000-013	Allen Bradley	Type CB	
R2	Same as R1				
R3	Resistor, comp, 20K ±5%, 1/4W	1-945000-193	Allen Bradley	Type CB	
R4	Same as R3				
R5	Resistor, film, 10K ±1%, 1/8W	1-945016-289			
R6	Same as R3				
R7	Resistor, comp, 10K ±5%, 1/4W	1-945000-186	Allen Bradley	Type CB	

SYMBOL NUMBER	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
R8	Same as R3				
R9	Same as R5				
R10	Same as R3				
R11	Same as R3				
R12	Same as R3				
R13	Same as R7				
R14	Same as R3				
R15	Same as R7				
R16	Same as R3				
R17	Same as R7				
R18	Same as R3				
R19	Resistor, comp, 82K ±5%, 1/4W	1-945000-208	Allen Bradley	Type CB	
R20	Resistor, comp, 470 ohms ±10%, 1/4W	1-945000-033	Allen Bradley	Type CB	
R21	Resistor, comp, 8.2K ±10%, 1/4W	1-945000-048	Allen Bradley	Type CB	

TG-1, TONE GENERATOR, A1 FREQUENCY SYNTHESIZER, PARTS LIST (contd)

SYMBOL NUMBER	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
R22	Resistor, variable 20 tunr 5K	1-945093-001			
R23	Resistor, comp 10K ±10%, 1/4W	1-945000-049	Allen Bradley	Type CB	
R24	Resistor, variable, 50K	1-956010-009	CTS	Type 201	
R25	Same as R20				
R26	Resistor, comp, 1 Meg ±10%, 1/4W	1-945000-073	Allen Bradley	Type CB	
R27	Same as R26				
R28	Resistor, film 1K ±10%, 1/8W	1-945016-193			
R29	Same as R28				
R30	Same as R23				
R31	Resistor, comp, ±5% (selected)	1-945000-	Allen Bradley	Type CB	
R32	Resistor, comp, ±5% (selected)	1-945000-	Allen Bradley	Type CB	
R33	Resistor, comp, ±5% (selected)	1-945000-	Allen Bradley	Type CB	
R34	Resistor, comp, ±5% (selected)	1-945000-	Allen Bradley	Type CB	

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST

REF DES	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
AR1	All	Integrated cct, 2-input 4-bit digital multiplexer	1-926047-002	Signetics	N8233B	
AR2	All	Same as AR1				
AR3	All	Same as AR1				
AR4	All	Same as AR1				
AR5	All	Same as AR1				
AR6	TG-1B -1C -1BP -1CP	Same as AR1				
AR7	TG-1B -1C -1BP -1CP	Same as AR1				
AR8	TG-1B -1C -1BP -1CP	Same as AR1				
AR9	TG-1B -1C -1BP -1CP	Same as AR1				

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N
AR10	TG-1B -1C -1BP -1CP	Same as AR1			
AR11	All	Integrated cct, operational amplifier	1-926048-001	Signetics	N5748A
AR12	All	Integrated cct, 2-input positive nand buffer	1-926007-006	TI	SN7437N
AR13	All	Same as AR12			
AR14	All	Integrated cct, dual nand schmitt trigger	1-926007-005	TI	SN7413N
AR15	All	Integrated cct, retriggerable monostable multivibrator with clear	1-926007-007	TI	SN74123N
AR16	All	Same as AR15			
AR17	All	Integrated cct, ±10 VDC regulator	1-926049-001	Signetics	SG3501D
AR18	All	Integrated cct, quad spst mos analog switch.	1-926050-001	RCA	CD4016AE

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
AR19	All	Integrated cct, dual positive and driver	1-926051-001	TI	SN75451A	
AR20	All	Same as AR19				
AR21	All	Integrated cct, J-K input flip flop	1-926007-012	TI	SN74107N	
AR22	All	Integrated cct, 3-input and gate	1-926053-001	Sprague	US7411A	
C1	All	Capacitor, elect 75 uf ±10% 3v	1-900106-001	Callins	2-85-ASD-75-3NP	
C2	All	Capacitor, elect, 800 uf ±10% 3V	1-900106-002	Callins	12-85-ASD-800-3NP	
C3	All	Same as C1				
C4	All	Same as C2				
C5	All	Capacitor, elect, 400 uf ±10% 3V	1-900106-003	Callins	8-85-ADS-400-3NP	
C6	All	Capacitor, elect, 4000 uf ±10% 3V	1-900107-001	Callins	10-85-PSD-4000-3NP	
C7	All	Same as C1				

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	Q
C8	All	Same as C2				
C9	All	Capacitor, met plastic 0.1 uf	1-900001-013	Amperex	C280AE	
C10	All	Same as C9				
C11	All	Capacitor, elect, 50 uf, 25V	1-900039-005	GI	984-122	
C12	All	Same as C11				
C13	All	Same as C11				
C14	All	Same as C11				
C15	All	Capacitor, met plastic, .01 uf	1-900001-001	Amperex	C280AE	
C16	All	Same as C15				
C17	All	Capacitor, elect 5 uf, 15V	1-900039-007	GI	984-9	
C18	All	Same as C17				
C19	All	Same as C9				
C20	All	Same as C9				
C21	All	Same as C9				

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	C
C22	All	Capacitor, mica, 10 pf ±5% 500V	1-900003-008	EMM	DM15	
C23	All	Same as C9				
C24	All	Same as C9				
C25	All	Same as C9				
C26	All	Same as C9				
C27	All	Capacitor, mica 1000pf ±5%	1-900003-056	EMM	DM15	
C28	All	Capacitor, mica 100pf ±5%	1-900003-030	EMM	DM15	
CR1	All	Diode, silicon	1-913007-002		1N4148	
CR2	All	Same as CR1				
CR3	All	Same as CR1				
CR4	All	Same as CR1				
CR5	All	Same as CR1				
CR6	All	Same as CR1				
CR7	All	Same as CR1				

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QT
CR8	All	Same as CR1				
CR9	All	Same as CR1				
J1	All	Connector, PC board	1-910105-006	USC	UPCRD22ST1	
J2	All	Same as J1				
J3	All	Same as J1				
Q1	All	Transistor, NPN-silicon	1-958000-001	Motorola	2N3904-5	
Q2	All	Transistor, NPN-silicon	1-958001-002	Motorola	MJE520	
Q3	All	Transistor, PNP-silicon	1-958001-001	Motorola	MJE370	
Q4	All	Same as Q1				
Q5	All	Same as Q3				
Q6	All	Same as Q2				
R1	All	Resistor, variable 20K	2-403320-001			
R2	All	Same as R1				

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QT
R3	All	Same as R1				
R4	All	Same as R1				
R5	All	Same as R1				
R6	All	Resistor, variable 10K	1-945007-007	CTS	Type X201	
R7	All	Same as R6				
R8	All	Same as R6				
R9	All	Same as R6				
R10	All	Resistor, variable 50K	1-945007-009	CTS	Type X201	
R11	All	Resistor, comp 470 ohm ±10%, 1/4W	1-945000-033	Allen Bradley	Type CB	
R12	All	Same as R11				
R13	All	Same as R11				
R14	All	Same as R11				
R15	All	Same as R11				
R16	All	Same as R11				

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QTY
R17	All	Same as R11				
R18	All	Same as R11				
R19	All	Same as R11				
R20	All	Same as R11				
R21	All	Same as R11				
R22	All	Same as R11				
R23	All	Same as R11				
R24	All	Same as R11				
R25	ALL	Same as R11				
R26	All	Same as R11				
R27	All	Same as R11				
R28	All	Same as R11				
R29	All	Same as R11				
R30	All	Same as R11				
R31	All	Same as R11				

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QT
R32	All	Same as R11				
R33	All	Same as R11				
R34	All	Same as R11				
R35	All	Same as R11				
R36	All	Same as R11				
R37	All	Same as R11				
R38	All	Same as R11				
R39	All	Same as R11				
R40	All	Same as R11				
R41	All	Same as R11				
R42	All	Same as R11				
R43	All	Same as R11				
R44	All	Same as R11				
R45	All	Same as R11				
R46	All	Same as R11				

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	OT
R47	All	Same as R11				
R48	All	Same as R11				
R49	All	Same as R11				
R50	All	Same as R11				
R51	All	Same as R11				
R52	All	Resistor, comp, 330 ohm ±10% 1/4W	1-945000-031	Allen Bradley	Type CB	
R53	All	Same as R11				
R54	All	Same as R52				
R55	All	Same as R11				
R56	All	Same as R52				
R57	All	Same as R11				
R58	All	Same as R52				
R59	All	Same as R11				
R60	All	Same as R52				

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	Q
R61	All	Same as R11				
R62	All	Same as R52				
R63	All	Same as R11				
R64	All	Same as R52				
R65	All	Same as R11				
R66	All	Same as R52				
R67	All	Same as R11				
R68	All	Same as R52				
R69	All	Same as R11				
R70	All	Same as R52				
R71	All	Same as R11				
R72	All	Same as R52				
R73	All	Same as R11				
R74	All	Same as R52				
R75	All	Same as R11				

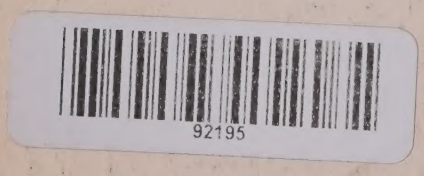
TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	QT
R76	All	Same as R52				
R77	All	Same as R11				
R78	All	Same as R52				
R79	All	Same as R11				
R80	All	Same as R52				
R81	All	Same as R11				
R82	All	Same as R52				
R83	All	Same as R11				
R84	All	Same as R52				
R85	All	Same as R11				
R86	All	Same as R52				
R87	All	Same as R11				
R88	All	Same as R52				
R89	All	Same as R11				
R90	All	Same as R52				

TG-1, TONE GENERATOR, A4 CARRIER BOARD, PARTS LIST (contd)

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N	C
R91	All	Same as R52				
R92	All	Same as R11				
R93	All	Resistor, comp, 1.5K ±10% 1/4W	1-945000-039	Allen Bradley	Type CB	
R94	All	Same as R11				
R95	All	Same as R93				
R96	All	Resistor, comp 50 ohm ±10%, 1/4W	1-945000-015			
R97	All	Same as R96				
R98	All	Resistor, comp, 390 ohms ±10%, 1/4W	1-945000-032	Allen Bradley	Type CB	
R99	All	Resistor, comp, 150 ohm ±10%, 1/4W	1-945000-027	Allen Bradley	Type CB	
R100	All	Same as R98				
R101	All	Same as R99				
R102	All	Same as R6				
R103	All	Same as R6				

SYMBOL NUMBER	APPLICABLE MODELS	DESCRIPTION	SINGER P/N	MFR NAME	MFR P/N
R104	All	Same as R6			
R105	All	Resistor, comp, 10K ±10%, 1/4W	1-945000-049	Allen Bradley	Type CB
R106	All	Resistor, comp, 20K ±10%, 1/4W	1-945000-193	Allen Bradley	Type CB
R107	All	Resistor, comp, 270 ohm ±10%, 1/4W	1-945000-030	Allen Bradley	Type CB
R108	All	Same as R107			
R109	All	Same as R107			
R110	All	Same as R107			
R111	All				
R112	All				
R113	All				
R114	All				
X1	All	Crystal 1.98 MHz.	1-403317-001		


92195